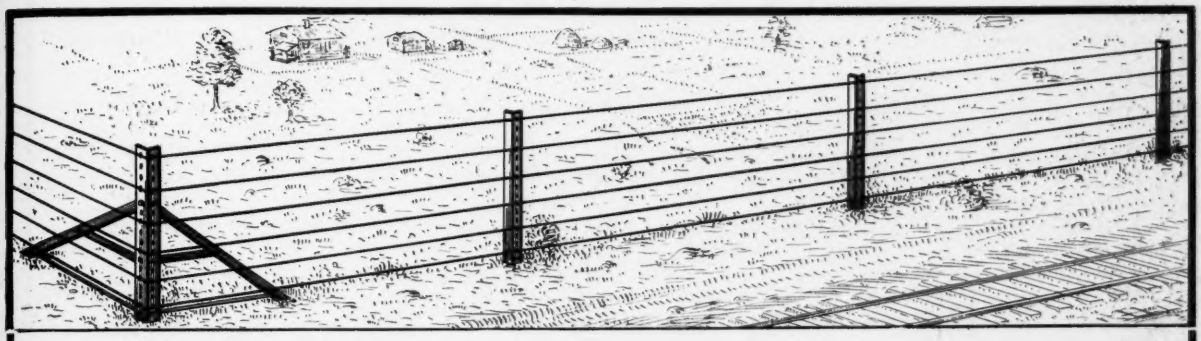
RAILWAY ENGINEERING AND MAINTENANCE OF WAY.

BRIDGES - BUILDINGS - CONTRACTING - SIGNALING - TRACK

New Series, Vol. IX
Old Series, Vol. XXVIII | *Chicago* | NOVEMBER, 1913 | *New York* | No. 11



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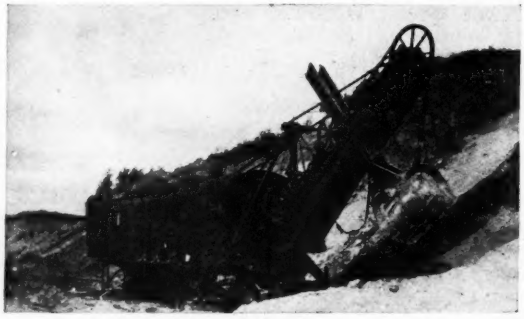

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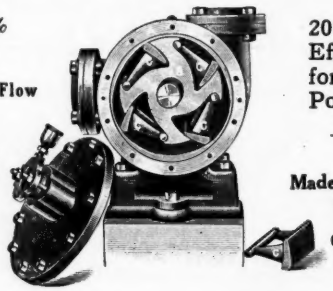

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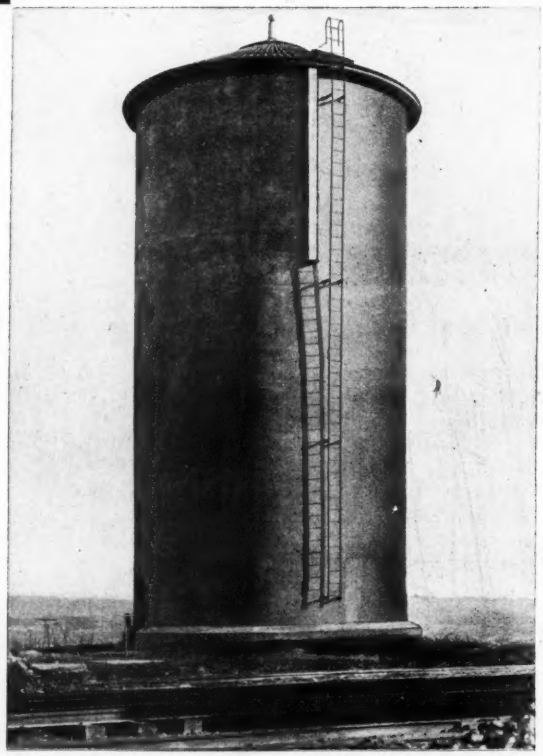

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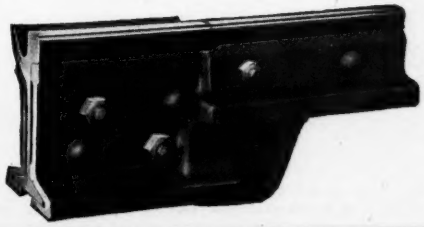

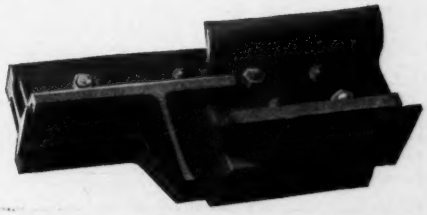

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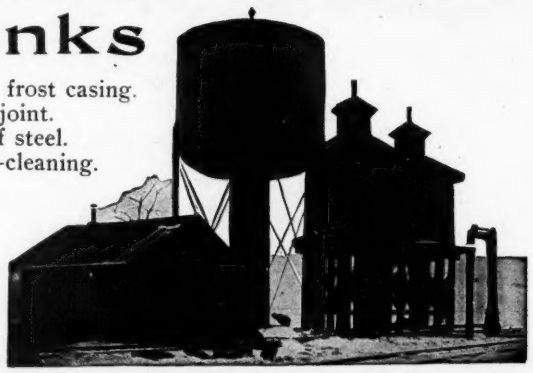

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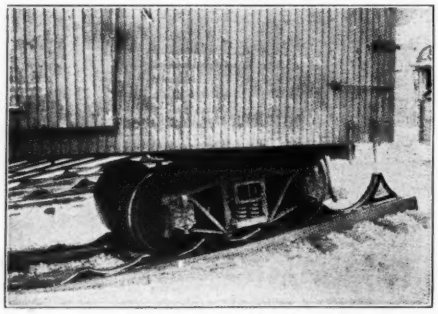

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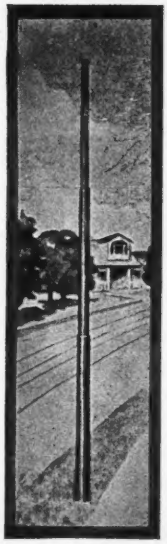

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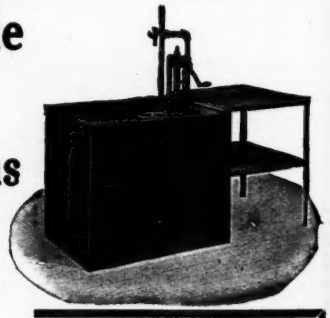

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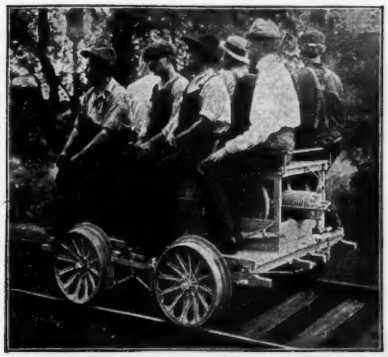

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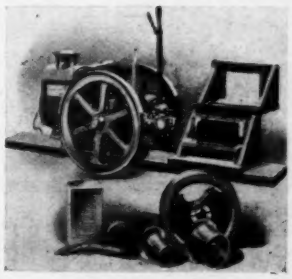

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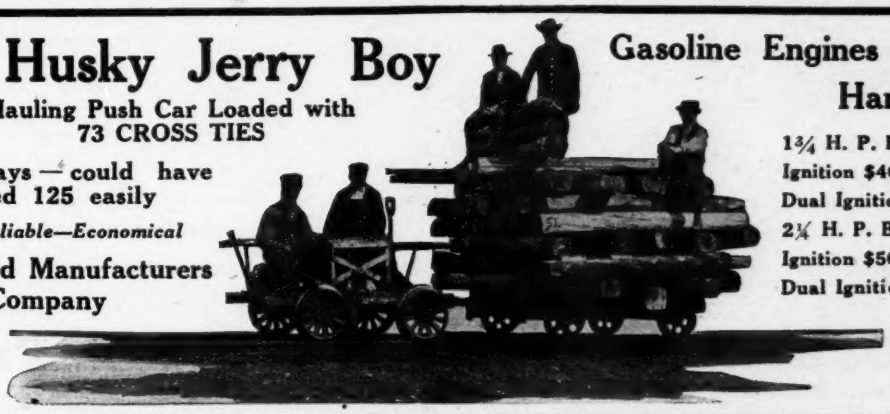

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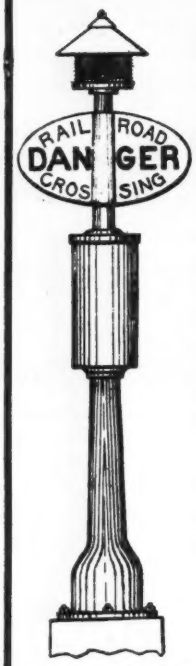

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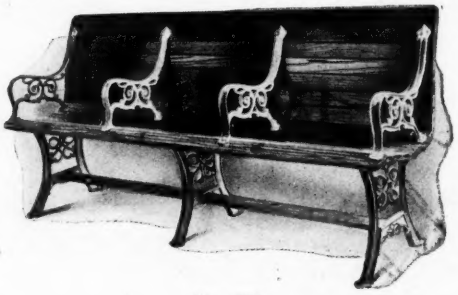

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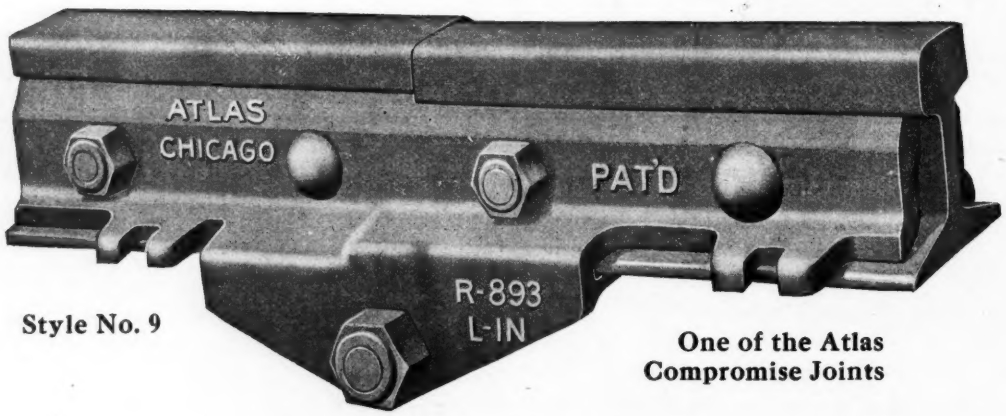

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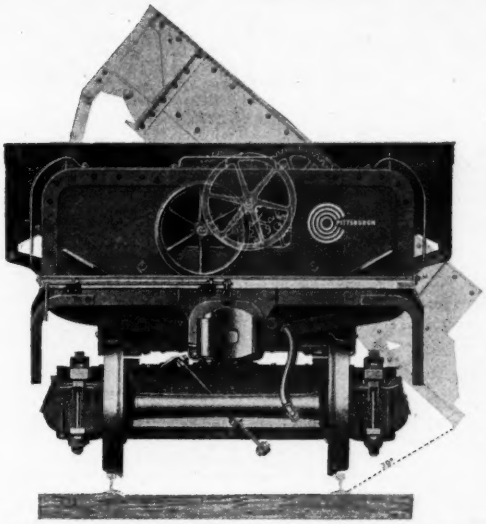

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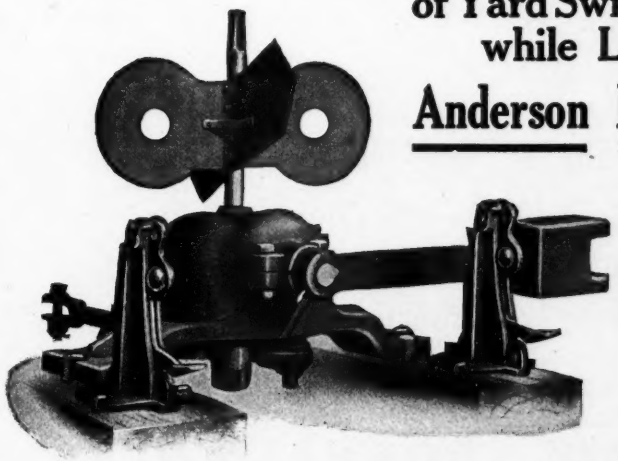

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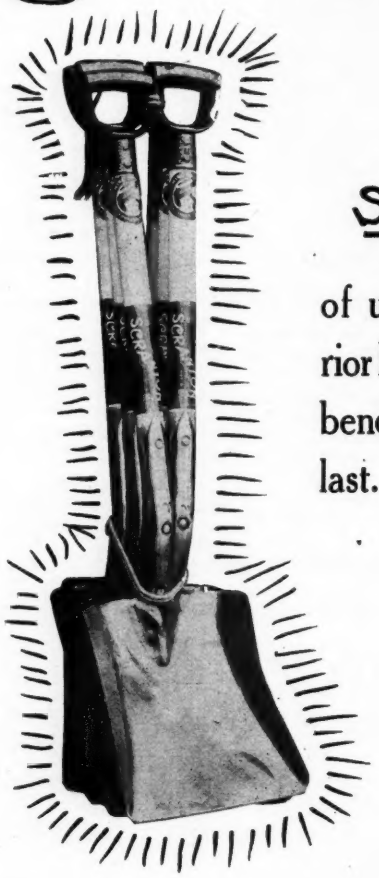

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of uniform steel, superior handles, and correct bend, lift and hang must last.

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New Series, Vol. 9
Old Series, Vol. 28
Chicago, November, 1913 No. 11

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*Illustrated.

Billerica Shops

WITH the opening of the Billerica shops of the Boston & Maine, the important features of which are described on another page of this issue, this road becomes more thoroughly and efficiently equipped for the repair of its equipment than possibly any other railway in the territory. The new repair facilities, as may be noted by reference to the article, are to be used in addition to those which have supplied the needs, more or less thoroughly, of the road heretofore.

It would seem, however, that those charged with the responsibility for efficient operation of the plant will experience difficulty in securing the proper labor to complete a thorough shop organization on account of the location of the plant. It is isolated from towns of any size; the village of North Billerica offering about the only possibilities in the way of housing the men. Of course, when an organization of forces is once perfected it will, in the nature of things, be more stable on this account; but variations in the size of the forces cannot but cause difficulty. In the case of necessary retrenchment, which usually takes the form of decrease in the payroll, there will be injustice to the men, and temporary increases will be productive of inefficiency on account of the fact that good men cannot be obtained.

The machine tool equipment is unusually complete and it seems that no expense has been saved in the purchase of the most modern machinery.

Owing to the swampy nature of the ground upon which the shops are located, some difficulty has been experienced in securing proper foundations for the buildings. A drift of boulders across the center of the tract interfered to an embarrassing extent in foundation and other sub-structure work. The steel work is set on concrete piling and it is interesting to note that in constructing the concrete foundations for the steel columns the base bolts were set solid instead of being placed in thimbles to allow for slight errors in the fabrication of the steel. This illustrated unusual confidence on the part of those responsible, as there could be no variations in dimensions. As was expected, however, the installation was made without difficulty.

Considerable difficulty was experienced with heavy machine foundations, due to carelessness on the part of certain machine tool manufacturers, who sent incomplete or erroneous dimensions for foundation construction. It would seem that machine tool builders should take steps to overcome this difficulty, since it is so unnecessary that these errors appear. Complete and accurate specifications in so far as they relate to foundation construction should be readily available in advance.

The shops will be in operation early in the spring of 1914, unless financial difficulties should arise to prevent. The plant is a credit to the railway, which has, through its own organization, handled more of the details of plans and construction than is customary.

Floods vs. Size of Waterways

IN investigating and designing waterways through railway embankments it has been the practice, until recently, to make the structures large enough to withstand only ordinary floods. The basis for this policy is reached by figuring the interest and depreciation on the larger and more permanent structures,

and comparing it with like items, with repairs and renewals added, for the smaller and therefore less permanent structures.

Nature frequently nullifies these assumptions by washing out stretches of track within a few months after completion. It is a fact that in nearly every vicinity the floods seem to become more severe and destructive after the first railway has been constructed. The actual facts are usually that the floods were underrated before because there was nothing to be greatly damaged. The reports of residents, for these reasons, are frequently unreliable and lead to underestimating the amount and rapidity of the run-off of flood waters.

The gradually growing demand for safety has probably had much to do with the growth of the practice of designing waterways of greater capacity, after collecting accurate data on the drainage areas, and the gradual elimination of culverts designed to be operated under hydraulic head. Water backing up due to flowing through a culvert designed for hydraulic head frequently causes suits for damage from surrounding land owners, who are demanding that railway waterways be made large enough to carry the water without greatly affecting the flow above or below them.

Poor Attention for Isolated Power Plants

INSTANCES are constantly coming to light of damage to equipment and railway operating machinery through the incompetence of employes. The wages of skilled laborers have steadily risen, till now many railways do not feel able to hire first-class men for work at isolated power plants.

Where an ordinary gasoline engine or electric motor is used for the generation of power, an intelligent and capable man should be hired as the operator. This is especially true of installations such as pumps for supplying water for locomotive watering tanks, motors for operating lift or draw spans, and for supplying power for interlocking plants. In each of these cases prolonged delay means interrupted train schedules and loss of money.

The above relates especially to the generation of power in comparatively small quantities. Where power is generated for operating large machine shops, etc., the importance of the work justifies—in fact, necessitates—the appointment of well-paid and competent attendants.

If it is a fact that railway finances will not permit of hiring competent attendants for small power plants, it becomes necessary to install at such places, if possible, machinery which is so simple in operation, so dependable in action, and so rugged in construction, that there will be small danger of the plant being incapacitated.

It is probable that more competent men could be hired without increase in the rate of pay, provided wider publicity was given to vacancies in railway service and a more thorough investigation given to the applicant's qualifications and experience.

Automatic machinery is being continually developed and its use extended, one of the recent developments being a coaling station which operates automatically when the motor is started, the mechanism requiring no attention from the operator.

The above is another instance of where the railways are adopting devices which relieve the laborer of most of the responsibility, a proceeding which seems to be necessary in view of the present condition of the labor market.

By the Ad. Editor

TRACK MEN and engineers realize the great difference which can be made in a man's efficiency if he can be kept on one class of work continuously. A laborer may be willing and work very hard, but if he is not experienced he will not accomplish as much as an experienced man who may not be putting forth half the effort. The quality and quantity of work turned out by a laborer depends largely on his experience—i. e., his training. If he becomes highly efficient, then he cheapens the manufacture of the railway's commodity—"transportation."

The same principle applies in the manufacture of railway supplies. The manufacturer who has a steadily growing business gradually obtains an organization which constantly becomes more efficient. The growth of the business makes possible the assignment of men to regular tasks in which each becomes proficient. The results are seen in a higher grade and more uniform product, and in decreased price to the consumer.

For this reason an official cannot go far wrong in specifying those materials for which a larger demand is being developed through conservative but persistent publicity methods.

THE SECRET OF SUCCESS.

The secret of success is not a secret. Nor is it something new. Nor is it something hard to secure. To become more successful, become more efficient. Do the little things better. So work that you will require less supervision. The least supervision is needed by the person who makes the fewest mistakes. Do what you can do and what you should do for the institution for which you are working, and do it in the right way, and the size of your income will take care of itself. Let your aim ever be to better the work you are doing. But remember always that you cannot better the work you are doing without bettering yourself. The thoughts that you think, the words that you speak, and the deeds you perform are making you either better or worse. Realize with Henley that you are the master of your fate and the captain of your soul. You can be what you will to be. Forget yourself in rendering service to others. If an employee, strive to make yourself of greater value to your employer. Look upon yourself as a manufacturer. Think of yourself as being in business for yourself. Regard yourself as a maker and seller of service, and ever bend your thought and your energies toward the improvement of your product. The wise manufacturer never injures his machine willfully. Your body, your mind, your soul serve as your plant. Eat and drink only that which will nourish your body, entertain only those thoughts that will enrich your mind, and if you feed your body with the best physical food and your mind with the best mental food you will build up a Service Factory that will find its products in constant demand. The world is hungry for Quality Service. It wants to pay for it. It is paying for all it can get. The market is not crowded. There is a chance for you right now. There is a chance for you right where you are. The time to start is Now. Your reward will take care of itself.—Thomas Dreier in Santa Fe Magazine.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS are conducting a large number of courses for railway employes. An example of the interest being aroused among railway men is shown by the number of students enrolled in the Florida East Coast Ry. In July there were 24 students enrolled and this number increased to 33 on August 1, to 34 on September 1, and to 41 on October 1. The number of lessons given in the meantime increased from 61 to 125. During the five weeks ending October 4, the total number of lessons received and corrected from railways employes was increased from 20,180 per week to 26,520 per week, the total being 121,244.

Billerica Shops, Boston & Maine R. R.

Owing to lack of capacity for repairing equipment, both car and locomotive, the Boston & Maine in the latter part of 1910 commenced the preliminary work for the construction of large repair shops near North Billerica, Mass., on a large tract of swampy ground purchased for the purpose. Previously the repair work on locomotives was distributed between Concord, N. H.; Lyndonville, Vt.; Keene, N. H., and Boston, Mass. All car work was distributed between Concord, N. H.; Fitchburg, Mass., and Boston, Mass. Billerica was selected as the most conveniently located available site.

General View, Billerica Shops, Looking North. Locomotive and Power Houses at Right, Passenger Car Buildings at Left.

The buildings now completed are as follows:

Locomotive erecting shop,	Dry kiln,
Coaling plant and cinder pit,	Car machine shop,
Stripping shed,	Car blacksmith shop,
Lye vat house,	Oil house,
Tire house,	Iron shed,
Blacksmith shop,	Passenger car shop,
Power house,	Paint shop,
Store house (and office),	Paint, varnish and oil house.

The lay-out includes plans for freight car shop and a planing mill in addition to the above. These buildings have not yet been constructed.

All of the main buildings are of steel frame brick construction, the steel work having been fabricated by the McClintic-Marshall Co. In arranging for foundations and trackage five hundred and sixty thousand feet of cut and filling earth was moved in grading. Of this work one hundred thousand yards was moved by the railway forces, the balance being Co., New York.

The foundations for all main buildings are on concrete piles of the McArthur "Pedestal" type. This work together with piers for columns was handled by the McArthur Concrete Pile & Foundation Co., of New York.

Nearly all of the buildings were constructed by W. M. Pike & Sons Co., of Lawrence, Mass. These buildings are of the monitor roof design with skylights manufactured by the National Skylight & Ventilating Co., of Rochester, N. Y., the roofing itself being the Barrett Specification.

Hot water for heating is supplied for all buildings from engine condensation in the power house.

Locomotive Erecting Shop.

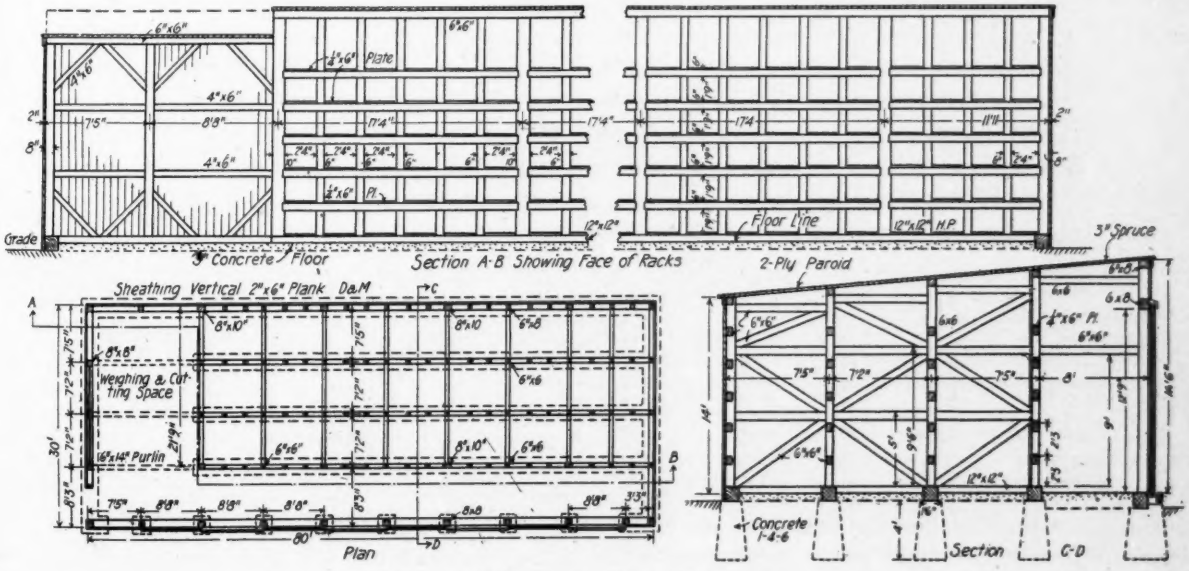
This shop is of the conventional longitudinal design. The building is 838' long by 160' wide and has a gallery for light machinery with crane service three-fourths of the length of the building.

This shop has three tracks running its entire length, the center track being equipped with two pits. Crane service is supplied by two sixty-five-ton, one ten-ton, and one seven-ton traveling bridge. In the machine bay are two ten-ton cranes with several power trolleys operating in connection. The tank and boiler section has one thirty-five-ton crane.

The flooring is of concrete on tamped gravel. The heavy machines are on concrete foundation. This shop is designed to turn out from forty to fifty engines per month and is arranged for large future extensions.

Blacksmith Shop.

This building is equipped with one track extending through from the erecting shop. The shop has twelve McCaslin double forges and six steam hammers. There are also four forging



Plan and Sections of Iron Storage Shed.

machines and one air hammer. The floor is of clay and cinders mixed and rolled.

This building is also arranged for future extension and is at present 332 feet long by 90 feet wide.

Storehouse and Office.

The north end of the storehouse building is used for the general shop office. It is constructed with two stories and in the office section the lower floor is to be used by the shop superintendent and staffs, and the upper floor by the storekeeper and staff. The building is of mill construction with a wooden floor on the second story and a concrete floor on the lower story.

The building is six hundred and seventy-two feet long by one hundred and ten feet wide and an elevator is located at each end of the stores section. These elevators are operated by electric hoists. A large material platform with track facilities extends the length of the building.

Power House.

The power house is 120' long by 114' wide. It is equipped with five 100-H. P. Babcock & Wilcox boilers arranged in two batteries and fed with Murphy stokers. The remaining boiler is hand fired for the purpose of burning chips and shavings.

These boilers are connected for induced draft with a 14' fan.

Interior of Storehouse, Second Floor.

A 12" main steam header near the floor at the rear of the boiler supplies steam directly for the two main engines and through an auxiliary header in the condenser room supplying the other machinery.

The feed water for the boilers is furnished by two high duty pumps located in the pump room. An additional supply can be furnished through injectors. In the boiler room are also located two fire pumps which also force service water through the plant.

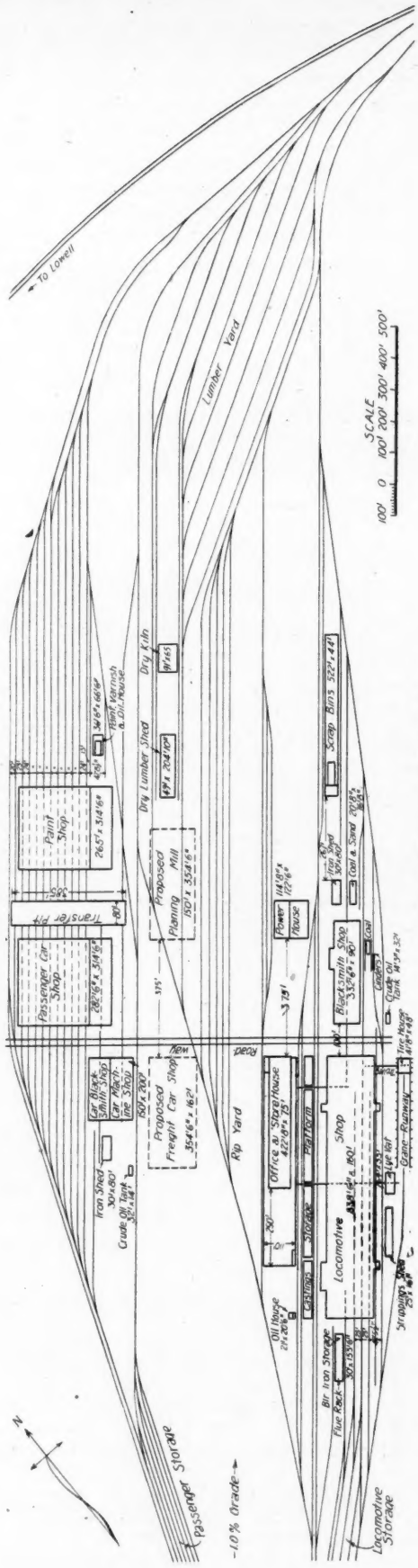
In the engine room are two 350-K. W. Rice & Sargent duplex engines direct connected to General Electric three-phase alternators. The excitation current is furnished by two 50-K. W. General Electric marine type direct current units or by a motor generator set.

There are two duplex air compressors of 3,000' capacity each and a 750-K. W. low pressure Curtis turbine located in the engine room. The turbine is operated by the exhaust steam of the engines and is connected with the condensor which with its turbine driven air and circulating pumps is located in the basement.

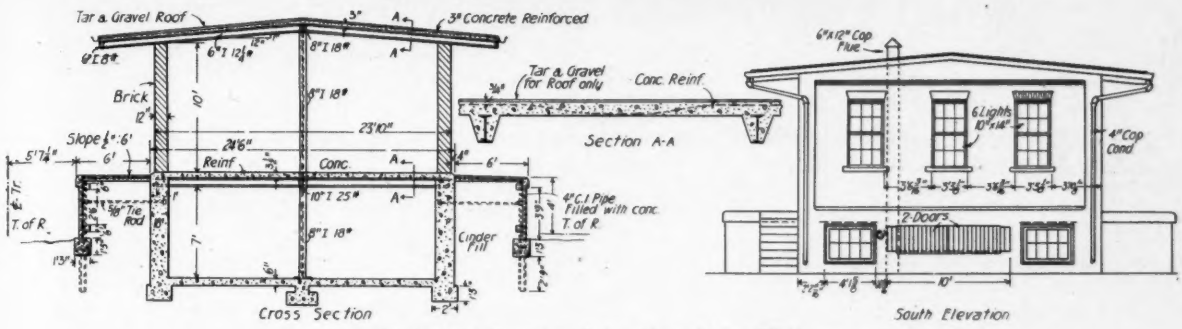
The circulating water comes from and returns to a cooling pond where the water is cooled by a set of spray nozzles.

The exhaust steam is also used to lead the water in the leading system for all the buildings, the heated water being circulated by turbine driven centrifugal pumps.

A semi-automatic conveying system is used for handling coal and ashes.



General Layout, Billerica Shops.



Section and Elevation, Paint, Varnish and Oil House

Car Blacksmith and Machine Shop.

This building is 200′ long by 150′ wide. The blacksmith and machine departments are separated by a fire wall. The flooring is of concrete in the machine room and of clay and cinders in the smith room. One track runs through each department.

Passenger Car Shop.

This building is 282′ long by 314′ wide. It is constructed with concrete floors and has ten tracks running to the transfer table pit between this shop and the paint shop. The transfer table is equipped with a tractor made by G. P. Nichols & Bro., of Chicago.

Passenger Car Paint Shop.

This building is 265′ long and 314′ wide to match the repair shop. It also has ten tracks served by the transfer table. It has concrete floors and no pits.

General.

The grading for the entire job was performed in part by the company's forces and in part by the Wilson-English Construction Co., of New York.

The concrete piles and foundations were constructed by the McArthur Concrete Pile & Foundation Co., of New York.

The structural steel was fabricated by the McClintic-Marshall Co., New York.

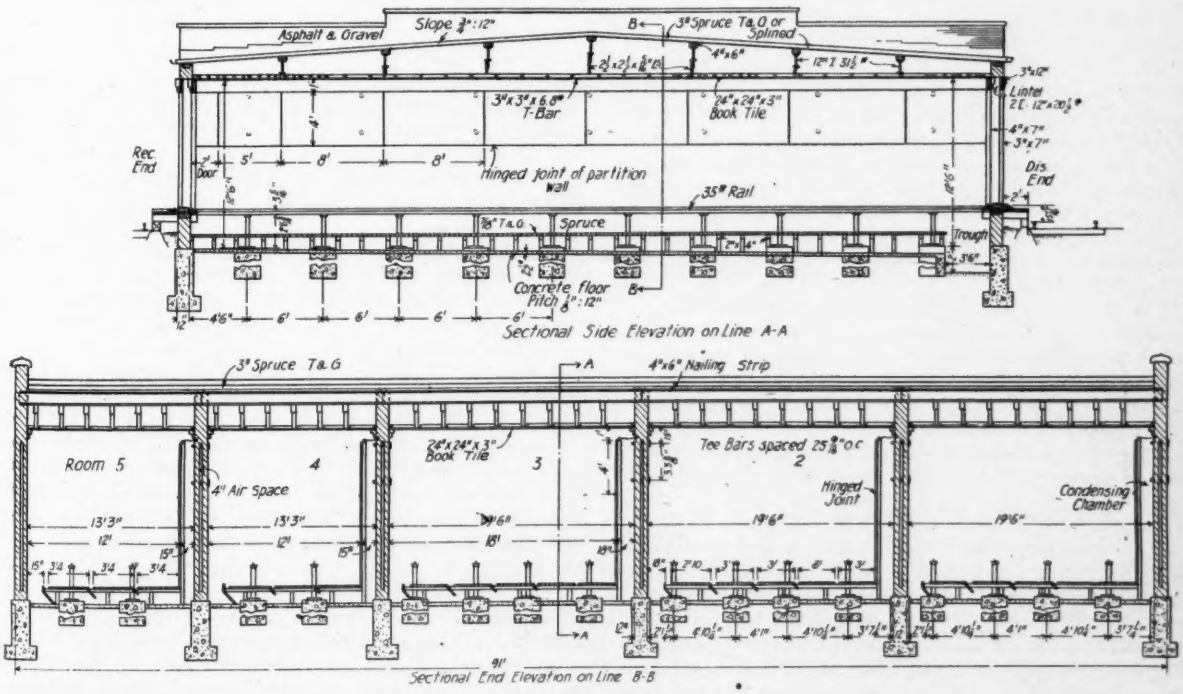
The general contract for superstructure was fulfilled by W. N. Pike & Sons, Lawrence, Mass.; three of the buildings, however, and the sewerage system were constructed by the C. A. Dodge Co., Cambridge, Mass.

The sprinkler and hydrant system was installed by the General Fire Extinguisher Co., Boston, Mass. The heating system was designed and constructed by the Jennison Co., Fitchburg, Mass. The wiring and transmission was handled by the railway forces.

Trackage, totaling twenty-five miles, with one hundred and twenty switches, was constructed principally of relay steel by the railway forces.

The oil storage system is that manufactured by the S. F. Bowser Co., Ft. Wayne, Ind.

Those connected with the railway company who have been instrumental in carrying the work to completion are as follows: F. K. Irwin, special engineer, who had charge of design and construction from inception to September, 1913; Henry Bartlett, mechanical superintendent, who was, of course, in charge of the machinery lay-out; F. C. Shepherd, engineer construction, who was given charge of the work after September 1, 1913; F. D. Hall, electrical engineer, who was in charge of power plant insulation, wiring, lighting, etc.; and S. P. Coffin, assistant engineer, who was actively in charge of the forces on the ground from the beginning of the work in January, 1911, to completion.



Dry Kiln, Billerca Shops

Annual Convention B. & B. Association

The Twenty-Third Annual Convention of the American Railway Bridge and Building Association was held at Windsor Hotel, Montreal, Que., October 21, 22, and 23.

President Killam called the convention to order at 10:00 a. m., October 21. The meeting was opened with prayer by Reverend Bruce Taylor. William McNab, principal assistant engineer of the Grand Trunk Ry., welcomed the convention in behalf of the railways and the citizens of Montreal.

B. F. Pickering, general foreman of bridges and buildings of the Boston & Maine Ry., replied to Mr. McNab's speech in an appropriate manner.

O. J. Travis, the first president of the association spoke briefly.

President Killam stated in his opening address that it is an excellent thing to meet in convention and find out how much we know by how much our neighbor knows. Following his speech, the convention took up the committee reports.

WATER SUPPLY.

The problems connected with railway water service are manifold and merit a great deal more attention than they have heretofore received, but it is gratifying to know that in recent years the subject of water supply has been given more consideration as its importance has been better realized. The amount of water consumed by our railroads is almost beyond comprehension and can be better understood by presenting comparative figures.

In considering the consumption of water on a railway system of 6,500 miles of road it was found that 16,500,000,000 gallons was used annually. For the fiscal year ending June 30, 1912, there was in operation in the United States 248,888 miles of railroad. Assuming the same average consumption on all railroads throughout the country there is consumed annually something like 632,076,789,000 gallons of water.

The pumpage of the Chicago city water works is 437,232,500 gallons per day. At this rate is would require 1,440 days, or nearly four years for the Chicago waterworks to pump the water used annually by the railroads of the United States.

The twelve reservoirs in the Croton water shed which supply New York City with water and which give a storage capacity of 104,443,000,000 gallons would furnish our railroads with water for about two months. Estimating the water stations to be spaced an average distance of 20 miles it means that it is necessary to maintain 12,444 water stations to pump the water required by more than 60,000 locomotives hauling annually 1,000,000,000 passengers and 2,000,000,000 tons of freight.

The sources of railway water supply may be divided into the following general classes: Water from (1) lakes and reservoirs; (2) creeks or rivers; (3) wells; (4) springs.

It of course follows that different methods must be followed in the selection of pumping facilities, depending largely upon the source of supply.

While fuel consumption is the most important factor in pumping efficiency, it often represents only a small part of the cost of operation. In many instances attendance and interest and depreciation charges make up the greater part of the operating expense, and should be given consideration in the selection of a power plant. The figures given on the costs of pumping include only the fuel or power costs as the other items of expense will be influenced largely by local conditions.

Internal Combustion Engines.

The development of the internal combustion engine to operate on the heavier low grade oils is necessary on account of the increased cost of gasoline. Various reasons have been given for the great increase in the cost of gasoline, the real reason being the direct action of the law of supply and demand.

Internal combustion engines using gasoline as a fuel have been in use for railway water service for a good many years with varying success, depending largely upon the care and attention given the engines.

The advantages claimed for an engine of this type over steam are: lower first cost, less floor space required, can be started more quickly than by firing up a boiler, economy in handling of fuel, proper installation presents a better fire risk and requires less attention. The latter feature is the principal claim to economy in a gasoline engine. Eliminating the services of a regular pumper, and giving the operation of the engine over to some employe in connection with other duties results in a nominal charge for attendance and reduces the cost of operation. This feature of operating a gasoline engine with little or no attention created the impression among many users that it can be run without giving it any attention whatever, except that required to start it. Consequently the operation of the engine in many instances is turned over to some one wholly incapable of properly handling any machinery and possessing no qualification except that of being conveniently located. The resulting effect has been a high cost for repairs and frequent delays and interruption to service, thus destroying the saving that should be expected.

A series of tests were made pumping from an eight inch well 19 feet deep, lifting water against 15 in. of vacuum, with a total head of 61 ft., with an 8 in. x 10 in. single cylinder double acting pump direct connected to a 6 h. p. four cycle horizontal gasoline engine equipped to run on kerosene and distillates as well as gasoline, controlled by a throttling governor.

The fuels used were:

Distillate 40	degree Baume..	Flash.....	150 Burn....145
Methyl alcohol..40.5	degree Baume..	Burns at same temperature.	
Kerosene 46	degree	Flash.....	124 Burn....170
Gasoline 62	degree	.....Burns at same temperature.	
Motor spirits....58	degree	.....Burns at same temperature.	

EFFICIENCY FUEL TESTS.

	Distillate	Alcohol	Kerosene	Gasoline	Motor Spirits
Lbs. fuel per hour.....	5.145	6.062	4.943	5.373	4.755
Cost fuel per hour....	.0347	.35	.06	.1313	.0975
Pump, rev. per min...	43.35	43.32	43.54	43.72	43.79
Pumped, gal. per min..	175.	177.8	176.8	176.8	178.1
Water horse power....	2.69	2.73	2.72	2.72	2.74
Lbs. of fuel per h. p. h.	1.91	2.22	1.91	1.97	1.74
Cost of fuel per h. p. h.	.0129	.1282	.0220	.0483	.0356
Cost of fuel per gallon.	.04625	.40	.08	.15	.13
Pints per hour.....	6	7	6	7	6
	deg.	deg.	deg.	deg.	deg.
Temp. of cyl. start....	165	90	135	46	46
Temp. of cyl. run.....	145	145	145	130	125
Temp. of inlet air.....	110	125	120	60	60

As will be seen from the above figures the distillate is the more economical of the fuels used, the cost per water horse power hour being 53 per cent of the cost of pumping with kerosene, and only 27 per cent of the cost of pumping with gasoline. This engine has been successfully operated on distillates from 36 deg. to 42 deg. Baume for a period of three years. The high cost of alcohol eliminates it as a fuel for pumping water and the result of the test is merely submitted as a comparative feature. No doubt better results could have been obtained by reducing the area of the combustion chamber as more compression is required to secure economical results from the use of alcohol in internal combustion engines. The results obtained from the use of kerosene were practically the same as from the distillate, the only difference being in the price of the two fuels. The gasoline test shows such results as might be obtained from the average gasoline engine under the same conditions. The fuel known as motor spirits which has been recently produced as a substitute for gasoline operates under the same conditions as gasoline. The only objectional feature about this oil is a disagreeable odor and it would perhaps be undesirable to use in certain localities.

A 12 h. p. four cycle gasoline engine with a hit and miss governor pulling a 7½ in. x 30 in. working barrel in a deep well was equipped with a generator for burning low grade oils. Comparative tests showed that the engine consumed the same amount of 39 deg. distillate per horse power hour as gasoline, the difference in cost of two fuels, however, showing a saving of .0434

per horse power hour in the use of the distillate. The cost of pumping water at this point is comparatively high, due to the fact that the water is pumped with a single acting deep well cylinder which is not as economical as pumping with a surface pump.

A test was conducted for a period of 30 days on two 20 h. p. vertical two cycle three port valveless engines, direct connected with a clutch to 9 in. x 10 in. single acting triplex pumps. During the test the engines were run alternately, one pumping days and one pumping nights, each engine running an average of ten hours out of twenty-four. No effort was made to prime the test, the object being merely to show the actual figures under average working conditions.

A total of 10,684,452 gallons of water was pumped against a head of 69 ft. at a cost of $50.20 for oil and lubricants; the fuel used was 39 deg. (Baume) power distillate, flash 126, fire 160; cost per gallon in tank car lots $.04⅝; the cost for fuel alone during the test was $36.14, a consumption of 1.025 lbs. of oil at a cost per h. p. h. of .006 cents. The lubricants and kerosene required for blow torches bring the total cost per h. p. h. up to .0087 cents. The cost per thousand gallons of water pumped was .0049 cents. The engine ran smoothly and maintained practically a constant speed, the variations in speed from readings taken from time to time during the test being from 398 to 403 r. p. m. No repairs of any kind were necessary and the formation of carbon in cylinders was not noticeable. However, the mufflers showed quite a deposit of carbon, there being several pounds of dry carbon in the two mufflers.

Electricity.

As many of the new mechanical facilities which are being installed are equipped with electric power plants, it is possible that an electrical pumping station in connection with the same will furnish water at a low cost, but where current is purchased a very low rate is required to show economy.

Steam Pumps.

Few railroads have paid sufficient attention to the type of steam plant installed at water stations, having little regard for the steam consumption of the pump, and will install any available boiler found unfit for any other service. Consequently the results obtained from many steam plants have not been as economical as they should be, for economical results cannot be secured from the use of obsolete and inefficient equipment.

Where a water station is known to be permanent a horizontal return tubular boiler is the proper boiler to install. A boiler of this type will cost about 100 per cent more to install than one of the vertical type but many of the boiler troubles will be eliminated and the saving effected will justify the additional expenditure.

The following table gives some comparative figures on the cost of pumping with a vertical boiler, return tubular boiler, and a fuel oil pumping unit:

Kind of power.....	Steam	Fuel oil	Steam
Type of pump.....	Duplex	Combined	Duplex
Size of pump.....	14x8½x10"	10x12 in.	14x8½x10 in.
Type of boiler.....	Vertical		Return tubular
Size of boiler.....	60x132 in.		54x156 in.
Head in feet.....	150	140	140
Gallons pumped.....	34,000	74,000	34,000
Gallons per minute..	283	412	283
Fuel used.....	800 lbs.	7½ gals.	360 lbs.
Cost per 1,000 gals..	.0235	.0106	.0108
Cost per h. p. h.....	.038	.018	.0183

The above figures were received in reply to inquiries sent out to various roads for data on the cost of pumping, and are typical of results obtained from vertical boilers as compared with horizontal return tubular boilers. It will be seen that the cost of pumping with steam using a return tubular boiler is practically the same as with fuel oil in this particular instance, and less than one half the cost of pumping with a vertical boiler.

Comparison Test of Fire Box and Return Tubular Boiler.

	Fire Box Boiler	Return Tubular Boiler
Size of boiler.....	75 h. p.	100 h. p.
Time of test.....	10 hours	10 hours
Coal used.....	4,450 lbs.	3,210 lbs.
Feed water used.....	2,305 gal.	2,167 gal.
Feed water per lb. coal....	4.3 lbs.	5.5 lbs.
Gals. water pumped.....	250,980	263,167
Gals. per minute.....	418	438
Coal used per 1,000 gal.....	17.7 lbs.	12.2 lbs.
Total head in feet.....	208	208
Cost of coal.....	$2.22	$1.60
Cost for coal per 1,000 gals.	.0088	.0061
Cost for coal per h. p. h...	.01	.007

The pumps used in the above test were two 14 in. x 18 in. x 20 in. x 12 in. duplex compound pumps, and the boilers were an old locomotive boiler and a walled in return tubular boiler. The return tubular boiler shows a saving of $0.62 per day of ten hours with coal at $1 per ton. With coal at $2.50 per ton this saving would amount to $1.55 per day or $565.75 per year, which capitalized at 5 per cent represents $11,315.00.

The coal used during the test was raw screenings which accounts for the low evaporation of the boilers. Where a washed nut or other good grade of coal was used the saving would be even greater than is shown above.

Committee: C. R. Knowles, Chairman; John Ewart, James Dupree, J. B. White, C. F. Warcup.

Discussion.

G. W. Rear—Old locomotive boilers serve very well for water pumping stations, and electricity is economical on large contracts.

A. S. Markley—We have also found good service in old locomotive boilers.

J. O'Neill—We have not found it economical to use old locomotive boilers. Steam is not as economical as gasoline for a small plant.

W. E. Alexander—Gasoline engines are very handy since they are ready to work as soon as the man arrives at the station. We get good results from vertical boilers .

* * * * *

An excellent paper on the "Action of Sea Water on Concrete," was read at this point by W. B. Mackenzie, of the Intercolonial Ry.

SEWERS AND DRAINS.

Sewers, as referred to in this subject, are intended to carry the excremated matter from railroad buildings to the main sewer, stream or cess-pool. The necessity for prompt and complete removal of sewage from the building and its disposal in a way the least offensive and injurious to health is a matter well worth consideration.

Drains are used in connection with railroads for carrying off surplus water from buildings and pits, and are simpler in construction than sewers. Ordinarily they do not require tight joints and traps, and they are often built of wood or common drain tile; but the large sizes are usually built of sewer tile.

In order to enable the committee to submit a report on this subject, letters of inquiry were sent to several officials of the various railroads throughout the country and answers were received to about twenty per cent of the letters.

After careful consideration as to the practice, experience and opinions of our contributors, we offer the following as a progress report, hoping that the few points touched upon will bring forth sufficient written matter and oral discussion to make the subject worthy of publication in our proceedings.

Material.—For sewers, cast iron pipe or vitrified sewer tile is recommended, as the conditions may require. Cast iron soil pipe should be of standard weight free from flaws, cracks, air bubbles or other imperfections, and it should be tested to 50 lbs. water pressure previous to tarring.

Vitrified sewer tile should be of standard thickness, good quality, salt glazed and well burnt throughout its thickness; impervious to moisture, smooth and well glazed on exterior and interior surfaces, free from cracks, flaws, blisters, fire cracks and other imperfections.

For drains, cast soil pipe or common sewer tile may be used, according to the local conditions.

General Considerations.—Sewers and drains should be carefully studied, surveyed and mapped out, both for greater accuracy of work and for location of the line afterwards. Particular stress is laid upon the importance of the grades, to avoid dips or depressions in the line which might work mischief with the system.

Angles in sewers and drains should never be used where it is practicable to do without them. Under ordinary conditions, where it is absolutely necessary to make an angle in a pipe line, long radius bends should be used, on account of less interruption to the flow. Where it is necessary to provide cleanout basins in a pipe line they may be made to act as the turn. Where the angle is greater than 45 degrees, a brick or concrete turn, with a cleanout basin, should be used.

Where necessary, traps should be placed in the pipe line and a hand hole should be provided in the pipe line near each trap, so that the trap can be cleaned or raked. The trap alone offers some resistance to the flow, and where a hand hole is made in the trap it adds another probability of obstruction.

Drains should be provided with a screen or grating at the inlet to keep sticks and rubbish from entering. Where dirt, sand, boiler washings and other sediments are liable to enter, a large catch basin should be constructed as near as possible to the inlet end. In this, materials may settle and may be removed from time to time. If the water carries a fine silt and the drain is of considerable length, other smaller catch basins should be placed in the line, for the same purpose as the larger one. The large basin should have a depth of at least three feet and the smaller ones two feet, below the line of the drain.

When a pipe line is laid in soft earth or in a marsh, it is often necessary to provide a foundation to keep the pipe from settling. We find various methods used, namely: the use of piling, cinders, a concrete base, timbers cross laid, wooden trestles, wooden cradles, and concrete cradles, all of which can be used advantageously. Matters of this kind are decided largely with respect to the material locally obtainable.

Where a drain or sewer is laid by contract, frequent inspection of the work should be made during construction to see that specifications are being carried out, and, where necessary, a regular inspector should be assigned to the work. It is a very difficult and expensive matter to locate a defect in a pipe line after it has been laid and covered.

Where water pressure is obtainable, pipe lines may be given a pressure test after laying and before they are covered up. A pipe line may also be tested with air or smoke.

Laying.—Where sewer pipe is laid under buildings or under granatoid or cement sidewalks or platforms, or under tracks, it should be of cast iron; otherwise it might be of best quality, salt-glazed, vitreous terra cotta. All cast iron pipes should be neatly and snugly fitted together, the joints being well caulked with picked oakum and molten soft pig lead, using 12 oz. of lead for each inch of diameter of pipe in which joints are made. No cement or putty joints should be permitted, and wherever connections are made they must be laid with "Y" branches, long curves and one-eighth bends.

Vitrified sewer tile should be laid with joints closely fitted together in such manner that there will be no shoulder or lack of uniformity of surface on the interior of the drain. Each joint should be wiped clean of mortar on the inside before another joint of pipe is laid. The joints should be well cemented together with a mixture of one part Portland tested cement and two parts clean sharp sand. The cement should be pressed into the space between the socket and spigot so as to fill it completely. After cementing the joints together, care must be taken not to disturb the pipe.

In laying common sewer tile for drains we recommend cementing the joints the same as in laying sewer pipe.

Committee: R. O. Elliott, chairman; A. F. Miller, E. C. Morrison, K. Peabody.

Discussion.

A. S. Markley.—I think that it is advisable to put the catch basin 200 feet below inlet of sewer instead of 100 ft.; otherwise we do not get the suspended materials to deposit in the basin.

Jas. Dupree.—Lead joints are necessary on soft foundation, to take care of movement of the pipes.

C. R. Knowles.—Iron pipe is used for severe service, and lead joints should therefore be used with it.

J. Ewart.—I think the amount of lead mentioned by the committee is too small. We use two pounds of lead per inch of diameter of the pipe.

The report was accepted with the exception of the last paragraph, which was eliminated.

MOTOR CARS FOR BRIDGE GANGS.

Out of 108 railways from which information was requested, 48 had in use 3,306 motor cars in all branches of railway work. Of these, 2,246 were being used by section men, 24 roads reported 270 in use by bridge gangs, while the rest were being used by inspectors and signal maintainers. The use of motor cars is, however, still in its infancy, and this seems to be especially true of motor cars for bridge gangs. Improvements are constantly being made which increase the reliability and usefulness of the cars.

Cost of Operation.

Costs of operation must be considered with the fact in mind that continual improvement is being made, and that the service conditions have a marked effect. To enable comparisons to be made, one road is now reducing the data on cost of operation of motor cars, to a ton-mile basis.

Analysis of costs of operation which have been obtained show the following:

Average Costs Per 100 Miles.

	Fuel.	Repairs.	Total.
Section	1.10	1.04	2.14
Bridge	1.20	1.60	2.80
Maintainers	0.45	...	...
Inspection	1.07	0.91	1.98
Miscellaneous	1.16	...	...

The cost per 100 miles is larger for bridge men, which is consistent with the larger size of bridge gangs.

The value of the time saved in one month during 1912 averaged $71.33 for 3 section gangs, and was $286.08 for one extra gang.

Type of Car.

Small engines have been installed on handcars and found satisfactory for section gangs, especially for gangs of two or three men, on account of their lighter weight. The more rigidly constructed motor cars are better adapted to the use of the larger bridge gangs.

The advantage of the 2-cycle engine is its simplicity of operation, while the manufacturers of the 4-cycle engine claim greater economy in oil. Other features to be considered in choosing a car are: method of cooling, air or water, depending on whether car is to be used for running continuously for long distances, or intermittently; type of drive, direct or friction, and power required.

Advantages of Motor Cars.

The advantages resulting from the use of motor cars by bridge men are: (1) territory can be lengthened; (2) economy in labor; (3) increased efficiency of laborer on account of not having to pump a handcar; (4) saving of time when transferring to a new job; (5) elimination of work train and way

freight expense in moving small amounts of material; (6) ease of collecting men for emergencies.

The companies using motor cars are practically unanimous in reporting favorably on their use, and contrary to the general idea prevailing, report that motor cars are very reliable and little time is lost by cars out of service.

Strict rules should be put into effect to safeguard the operation of motor cars. Men should be required to obtain information at every telegraph or telephone station; to flag ahead through especially dangerous territory; to limit the speed of cars; to allow only employes in discharge of their duties to use the cars; to approach highway crossings carefully; to carry proper lights after dark, etc.

Conclusion.

The method of using hand power to propel bridge men and tools over the road is obsolete; the gasoline motor car has ceased to be an experiment, and in the hands of careful men, will result in a saving to the company, and comfort to the men.

Recommended Requirements of Motor Cars.

The car should be as light as possible consistent with required strength, and should not weigh more than 1,000 lbs. The most of the weight should be over the loose wheels, to facilitate taking the car off the track. Small pipes, which freeze quickly, should not be used for cooling. Water cooling should not be added if necessitating very much additional weight.

The car should be designed to run either way at the same speed, with equal safety. The motor should be started with the car at rest, and car started by a clutch or belt.

The maximum speed possible should not exceed 20 miles per hour. It is very desirable to have at least two speeds in either direction to enable the car to pull heavy loads up steep grades at low speed, and at increased speed over light grades.

The car should be designed as simply as possible, with all parts easily accessible.

Discussion.

G. W. Rear.—I believe motor cars should be furnished, but they should be so designed that they cannot exceed a speed of 15 miles per hour.

Jas. Dupree.—I have a small speeder which has travelled 11,930 miles with little expense for repairs. This car travels 50 miles on one gallon of gasoline.

TEMPORARY STRUCTURES FOR SUPPORTING TRACKS DURING THE CONSTRUCTION OF PERMANENT WORK, SEWERS, ETC.

Your committee prepared a set of 15 questions which were sent out in the form of a printed circular letter to 240 members of the association and to other railroad officials. At the time of writing this report 58 replies had been received from 52 different railroads. After studying these replies it was decided that the information contained therein could best be presented in a summary which was accordingly prepared and is made a part of this report. It was also thought advisable to print a portion of these replies, giving the most direct information, as part of this report. Although plans accompanied many of the replies, in practically all cases the practice is to follow as closely as possible standard trestle construction and it was not therefore deemed wise to burden the report with these standard plans.

List of Questions and Summary of Replies.

1. In locations where there has been no opening in the roadbed, do you put in temporary stringers and ties first, or drive piles first? Give reasons for your practice.

In looking over the replies it will be noticed that there is practically a unanimity of opinion as to the best method of making an opening under the track, as out of the 58 replies received 45 recommended driving the piles first, while 4 prefer to put in the stringers first and drive the piles afterwards.

2. In locations similar to the above is your first choice piles, framed bents or crib work where conditions will permit the use of either? Give reason for your practice.

Forty-seven reported favoring piles as first choice, two favored framed bents and four favored crib work.

3. To what depth do you excavate on each drift when using framed supports or locations similar to the above mentioned?

Eighteen reported that this method was not used, nine did not answer the question, six replied that the depth depended on the character of the ground, seven reported depths ranging from 12 in. to 15 ft., and the remaining replies were so worded that it was evident that the writers are not ardent supporters of this method of work.

4. What is the standard length of span for falsework?

The standard length of span for falsework as reported ranges from 10 ft. to 32 ft. and in most cases is the same as the standard trestle span, being changed to fit local conditions on a particular piece of work.

5. What is your practice on falsework spans longer than the standard?

In increasing the length of span the common practice is to first add more stringers and some use second-hand I-beams, old girders or even trusses.

6. What width and depth of opening limits the use of stringers only, resting on earth at each end?

The answers received show that each of the writers has his own way of handling a case of this kind and that the methods as reported are nearly all different in actual figures given.

7. At what depth of fill would you tunnel instead of trestle?

8. What do you recommend for supporting tracks when tunneling process is used?

Questions 7 and 8 were also answered in such a manner as to indicate that there was a considerable difference of opinion regarding the best way to do work of this kind, the depth of fill given varying from 10 to 50 ft. There is also a difference of opinion as to the amount of support needed for the track.

9. Do you prefer framed, or pile bents, or grillage in supporting tracks when rebuilding bridges, where the bottom permits of framed bents?

Twenty-six replies favored pile bents, 21 favored framed bents, one favored grillage and the remainder would use either pile or framed depending on the character of the ground.

10. Do you recommend a detour temporary trestle for traffic, or a trestle under the existing bridge to permit dismantling the structure and carrying traffic in the reconstruction of bridges? At what limit of height of trestle do you consider that to be the governing feature?

Twenty-two reported not being in favor of using a detour trestle, eight reported in favor of it and six reported no experience or did not answer. The remaining replies are either given in the abstracts from the letters or can be classified among those reporting that they would use either method, the choice depending on the volume of traffic, how complicated the erection of the new bridge was and the comparative cost. The second half of the question was answered by 12 who gave figures varying from 10 ft. to 100 ft. as their idea of the height of the limiting trestle. Several others stated that they did not consider the height of trestle the governing feature.

11. Do you recommend building a new bridge complete on horses on one side, and rolling it in, or supporting the old structure on falsework and rebuilding in place?

The answers received to this question are hard to classify in two classes. The general opinion seems to be that with trusses it is better to build in place and with girders to either lower them in place with derricks, steam cranes or gallows frame, or to erect them at one side and roll in.

12. When renewing steel structures is it advisable to take out the old metal floor system, replacing it with timber, or leave it until the new superstructure is ready to be put in when placing the temporary trestle for traffic and dismantling under the old structure? Give details of method used.

Twenty-four replied that they favored leaving in the old

floor system, five favored removing it, eleven reported no experience or did not answer, two that the method depended on the structure and the remaining replies went into such detail that they are not given in the summary.

13. In rocky bottom do you use long sills for the whole horse, or short sills for separate posts, or omit the sills altogether on temporary falsework where the bottom is uneven?

Eight replies favored the use of long sills leveled upon and anchor-bolted to the rock, nine favored short sills, 22 would omit sills altogether, five did not answer, three stated that the method would depend on the character of the bottom and the velocity of the stream.

14. Bracing. Details of, for (a) simple trestle; (b) double deck; that is, with pony bents.

15. Pony bents—how attached to main bents (scab plates, metal or wood, bolted or nailed). Do you use runner timbers or girts on top of main bents?

Twenty-nine answers to question 14 were received, and, as already stated, the practice seems to follow very closely the standard trestle plan of each individual road. This is also true of the 35 replies received in answer to question 15.

Recommendations.

In concluding this report the committee feels that it is proper for it to make certain recommendations as to the best and safest way to perform work covered by this report in actual practice.

The committee recommends that piles be driven before stringers are put in, as they can be driven so that they will be directly under the stringers and will not have to be pulled or jacked into line; the fill under the track is not badly disturbed when putting in caps and only a small amount of blocking is needed to keep the track safe for full speed of trains, and the work of placing stringers is made easier by having caps in place to slide the stringers on.

In cases where there is a choice of piles, framed bents or crib work, the committee would recommend that as a general rule piles be used.

In places where the bottom is soft or uncertain, or where there is the slightest chance for scour by water, the committee would recommend that piles be always used, and that they be driven, if possible, at least 4 ft. below the bottom of the proposed excavation.

The method of excavating on each drift when using framed supports in locations such as the above, as already stated, does not appear to be favored by many members and the committee feels that no definite recommendations can be made, as the depth very largely depends on the character of the material in the roadbed and the time available for work between trains.

The committee would recommend that where local conditions permit, the span length be the same as the standard trestle span, which will permit of using stringers from stock, and in many cases second-hand material can be used.

On spans longer than safe timber stringer construction the committee recommends the use of I-beams or girders.

The committee recommends that whenever stringers only are used they be supported on cross-sills at the ends, except when the width of excavation is to be small compared to the length of stringer. As a general rule the depth which can be excavated is such that a 1½:1 slope from each side of the bottom of the excavation will not undermine the sills under the ends of the stringers. This cannot be given as a rule to be always followed, as in some soils a 1:1 slope would be safe and in others a 2:1 slope would be unsafe.

The replies to the two questions regarding tunneling under tracks, as already stated, show such a diversity of opinion among the members and others, and there was so little actual construction experience reported that the committee prefers to leave these two questions without any definite recommendations, hoping that in the discussion of the reports at the convention some valuable information will be obtained.

The committee recommends the use of piles, rather than framed bents or grillage, as a general rule, as being safer.

The committee recommends the use of a detour trestle when a suitable alignment of track can be obtained and the cost of this method will not be materially more than of a trestle in place.

The committee recommends the method of rolling in a bridge when conditions will permit, and the expense is not materially greater. In cases where it is not possible to roll in and the new bridge must be rebuilt in place, the committee recommends that whenever possible the old metal floor system be left in and that the falsework be designed with this in view.

Where the bottom is uneven, the committee recommends that short sills be used when possible, unless the bottom is rock, in which case the sills may be omitted entirely; in either of these cases care should be taken to have all bents well braced with crossbraces as low as possible.

The recommendation of the committee on the question of bracing is that the standard trestle plan be followed in detail as far as possible.

The committee recommends the use of wooden scab plates on temporary work, securely spiked or bolted; it also recommends the use of runner timbers or girts in all cases at every break in the uprights.

Committee: W. C. Whitney, Chairman; J. B. Sheldon, J. P. Canty, G. Aldrich.

Discussion.

R. H. Reid.—We maintain full speed wherever possible over falsework.

J. S. Robinson.—When banks are no more than 12 ft. high, we drive piles when putting in culvert pipe; when at greater depths, we tunnel through without piles.

CATTLE GUARDS.

General Considerations.

There are two principal and elementary characteristics pertaining to the installation of cattle guards: First, the necessity therefor; and, second, type of structure. Necessity may be considered the result of two conditions: statute requirements and industrial economy; or, in other words, installation of stock guards may be required by the laws of the commonwealth, or it may be necessary for economical reasons, in which latter case the second elementary characteristic, type of structure, has an exceedingly important bearing. Accordingly, inquiries, segregated as between legal features and physical features, were sent to officials of 127 railroads in the United States and Canada, each of these roads being over 100 miles in length. Replies were received from 75 railroads, aggregating 134,239 miles of road.

Legal Phase.

A compilation of the laws of the various states regarding installation of cattle guards was made in 1903 by the standing committee on "Signs, Fences and Crossings" in the American Railway Engineering Association, which compilation was published in the proceedings of that association. The committee considered it advisable to ascertain if any important changes had been made in the statutes of the various states since the date of the former compilation.

As might be expected, these inquiries brought out a diversity of opinion as to the legal status in any one state. For example, several railroads operating in the same state answered the questions different for that state, thus showing widely varying interpretations of the statutes therein. Closely coupled with the legal phase of the situation is the element of industrial economy. Generally, whether required by statute or not, stock guards are not so essential from an economical standpoint in regions where but few domestic animals are raised as they are in those districts where large numbers are kept. Statistics have therefore been compiled to show the relative importance in this respect of the various states in the United States and Canada. While it is true that some relation between the number of animals in any one state and the area of that state

should in some manner be shown, yet it is evident that not much information of value would thereby be derived, for the reason that railroad mileage per square mile of area varies widely in the different states. These statements show the numbers of domestic animals in each state and percentage of national production in that state, of cattle, horses and mules in one group and sheep and swine in another.

Replies indicate that there is no legal protection afforded by the installation of stock guards, and where stock is killed contemporaneously with the maintenance of guards in good condition, claims are legally allowed on the assumption that the guards are not effective barriers, although in perfect order. It also appears that neither the approval of type by railroad or public utilities commissions nor conformity to statute requirements in design relieves the railroads from responsibility for stock killed. There would therefore seem to be no other alternative than the past practice of installing guards in strict conformity to local laws, allowing the matter of efficiency to rest with the available types of guards thus far devised.

Physical Phase.

To ascertain the present practice in installation and maintenance of stock guards the committee requested from the various railway companies answers to the following inquiries:

1. Do your standards provide for whitewashing or painting, in distinctive colors, stock guards or any of their appurtenances?
2. Does such painting or whitewashing in your opinion, assist the device in its purpose of turning stock?
3. Do your instructions to the maintenance of way department provide for removal of track sections of surface guards during winter months, to prevent accumulation of snow and ice?
4. Are your guards maintained by track forces or by B. & B. forces?
5. Are you contemplating any changes in type or detail of your standard guard and if so to what extent?
6. Will you please attach hereto a copy of plan of your standard stock guard? If such plan is not available will you please mention trade name or designate type of guard used most extensively on your line?

While the standard plans of 78.5 per cent of the mileage reporting provide for painting of whitewashing guards or some of their appurtenant parts, yet the opinion of engineers is about evenly divided as to the efficacy of such coating in barring stock. It seems to be quite the general opinion, however, that at least the wing fences should be maintained in white.

Only a very small percentage of mileage reported a practice of removing track sections of surface guards during winter season. The maintenance of guards on 85.92 per cent of the mileage is performed by track forces, although on a portion of such mileage the installation of guards is effected by B. & B. forces.

One railroad reports it economical to eliminate guards entirely as fast as they need renewal, and some of the eastern lines report few guards in use because of recent track elevation or grade crossing elimination. It is to be noted that on a small percentage of mileage reporting, pit guards are still in use and that on a large percentage some types of modified pit guards are standard. By far the greater mileage, 81.26 per cent of the total, employs one of the several forms of surface guard, and a decided preference is for a wooden slat design.

Conclusions.

After a study of the entire situation and thorough consideration of all the information at hand, the committee begs to offer the following suggestions and conclusions:

Legal Status.—There has been recently very little, if any, change in the legal status of the matter. Where there are railroad or public utilities commissions, the approval of such commissions of the type of guard installed does not afford protection in stock claims, nor does conformity to statute requirements effect any material advantage. Notwithstanding this fact, an endeavor must be made to carry out both the spirit and the letter of the law, and in such effort that device of greatest known efficiency consistent with safety should be selected. Neither statute requirement nor the demands of social and industrial economy can be construed to justify the slightest sacrifice of safety in train operation.

Modified Pit Guards.—Realizing the effectiveness of the old pit guard, engineers have spent considerable study and effort in the design of a structure embodying therein only those features of the pit guard which are positive stock barriers without introducing the element of danger. The result is seen in the several types of modified pit guards, and while these all may be said to be thoroughly effective as barriers, it is questionable whether some of them have eliminated all possible chance of danger. For example, a pit with stringers and cross ties may be impassable for stock, but neglecting the matter of expense, the bridging of an opening eight or ten feet long in this manner constitutes at least a very undesirable structure in a railway roadbed. Moreover such a structure does not entirely avoid the possibility of holding fast on the track a frightened animal with broken or entangled legs.

A decidedly better construction, and one which is virtually as effective, is another type of modified pit guard consisting essentially of deep cross ties so spaced in proportion to their depth as to afford no knee room for an animal in taking a step. By making the cross ties of sufficient depth for barring the larger animals it also serves as a barrier to the shorter-legged animals, sheep and swine.

This type evidently embodies the correct preventive principles, for it neither injures the feet of animals nor presents the slightest opportunity for entrapping even the smallest hoof. The ties with chamfered upper corners are spaced by means of guard timbers sufficiently close to afford no unusually abrupt obstruction to the passage of derailed wheels. The main objection to the design would seem to be excessive cost of installation and maintenance. Nearly the same principle, namely, that of preventing an animal from taking additional steps even after having made one step, and allowing it to withdraw the foot without injury thereto, seems to have been the result sought in a few of the patented guards, nearly all of which have been abandoned because of practical consideration.

Metal Surface Guards.—Owing to a minimum of objections to surface guards from an operating standpoint, more attention has been given to their design than to any other type. In the various kinds of metal surface guards the principal recent developments consist in the use of devices designed to render the passage of an animal thereover impossible by reason of painful injuries inflicted on its feet. This is evidently an incorrect principle, since animals, unlike the human family, cannot be disciplined by example, and the desired result would apparently be more satisfactorily accomplished by the erection of a barrier so formidable in outward appearance as to be shunned by animals of every description. Almost all commercial types of metal surface guards have some serious inherent objections, and those which are somewhat effective in turning the larger animals are usually a menace in other respects.

Wooden Surface Guards.—It is doubtless due to the many well known objections and shortcomings of most of the metal surface guards that the wooden slat guard is used so extensively, and while some of the bad features and lack of universal efficacy of the metal is present in the wood, yet there are so many other desirable characteristics in the wooden slat type as to render it the best form of surface guard. Of late years the important changes in its design have had more to do with the method of attaching the slats to the ties rather than to any variations in general style. While there has been quite a diversity of design in cross-section of slat and method of packing, these differences are the result of practical and construc-

tive considerations, and apparently do not have any material effect on the guard as a stock barrier.

Painting.—Various attempts have been made in the past to lend aid to the efficiency of stock guards by the use of different styles of painting, the object in view being an appeal to the natural instincts of animals to shun objects of strange or peculiar appearance. Not much success has attended these efforts, and while paint is sometimes applied to the guard proper as a protection to the material of which it is constructed, any kind of coating is almost universally limited to the aprons and wing fences. The futility of trying to maintain any part of the guard proper in distinctive colors is self-evident, while the general utility of maintaining aprons and wing fences in white will be instantly recognized. As between the use of whitewash and cold water paint for this purpose, little can be said in favor of whitewash, for even though the cost of the cold water paint itself be double that of whitewash, only about one-third the number of applications are necessary to maintain the desired appearance.

In view of the foregoing observations, the conclusions of the committee may be summarized as follows:

1. Conformity to law in the installation and maintenance of stock guards is essential insofar as such conformity is a physical possibility without interposing any obstacles to the safety of train operation.
2. Climatic conditions, statute requirements, range laws and scope of animal industry all have a bearing on proper type of guard, and it would therefore seem impossible for any one design to satisfactorily meet the demands of the various localities.
3. It is more difficult to erect positive barriers against stock accustomed to roaming wide areas of public domain than against more thoroughly domesticated animals.
4. At the present time there is known no absolutely effective guard entirely free from objectionable features.
5. Elimination of objectionable or dangerous features usually necessitates a sacrifice of efficiency.
6. Wide variations in cost of installation, repairs and renewals, as well as in cost of general maintenance of track are possible without affecting the efficacy of the guard as a stock barrier.
7. Generally wooden slat surface guards embody a minimum of objectionable features and are probably just as efficient as most types of metal surface guards.
8. Aprons and at least the adjacent panels of wing fences should be maintained in white, and for this purpose paint is decidedly preferable to whitewash.

Arthur Ridgway, Chairman.

Discussion.

G. W. Rear.—The danger of the pit guard is over-rated. We use slat guards in populated districts, and modified pit guards elsewhere.

A. S. Markley.—Pit guards fill up with snow, etc., and are objectionable in winter.

J. M. Staten.—At the test conducted by the Roadmasters' Association, cattle went over every guard except the old tie guard.

President Killam.—A test of a large number of guards was made at Ottawa by the government to determine relative efficiency of different types. No conclusions could be drawn from these tests.

SNOW FENCES.

The opinions as to the merits of snow fences expressed in replies to our circular letter were not unanimous regarding their advantages. It is the belief of the commitee that where conditions prevent the placing of fences in advantageous positions, no benefits and much harm may result from their use. To make this point clear the first essential to the use of snow fences is that there shall be sufficient space between the cut and the nearest string of fence (assuming that the worst places require more than one row) to prevent the drift formed by this fence from extending into the cut. Experience based upon personal observation during one severe winter will enable one to decide upon the proper location of the fence. It should, of course, be placed as nearly windward from the cut to be protected as possible. Because of the varying direction of the wind, this will not always be possible, but the prevailing direction will govern. It is probably true that in most locations nearly all the bad storms come from one direction. A second string of fence should be placed parallel with the first and far enough away so that its drift will not ordinarily lap over the first. Additional strings of fence as required can be located in the same manner. It is evident that if these parallel rows of fence cannot for any reason be placed far enough apart or far enough from the cut to prevent the drift from forming in the cut, harm rather than benefit will result. In this way, in agricultural communities where the railways own only a narrow right of way, snow fences cannot be used advantageously.

At the higher elevations on the Union Pacific, where the greater portion of the land has but little value for other than grazing purposes, the company has the privilege of locating its fences to secure the best results and it will frequently place four or five parallel rows of fence spaced 150 to 200 ft. apart where the land slopes downward towards the cut to be protected. On the other hand, where the ground rises abruptly towards the cut, it is necessary to place these strings 50 ft. or even a lesser distance apart.

Mr. R. Budd, chief engineer of the Great Northern Ry., advises that tree planting is being done to a large extent in eastern Montana, North Dakota and Minnesota, and is proving a very effective means of protection against winds blowing across the track. The same effect is produced where sage brush or any other form of vegetation provides a lodgment for the snow.

On one branch of the Oregon Short Line, owning a narrow right of way where, due to altitude, the seasons are short and the snowfall heavy with considerable wind, the adjoining farmers oppose the accumulation of drifts beyond the natural snowfalls. Much trouble from snow results and other forms of protection must be employed by the railway.

With reference to the advisability of snow fences, Mr. T. C. Burpee, engineer of maintenance of the Intercolonial Ry., advises: "I am not as favorable to the use of snow fences as some are, for I believe that in a great many instances they create more trouble than they prevent, especially where they are placed within 50 ft. of the track, in which case they create a snow bank to the height of the snow fence, after which the snow drifts on the track much higher than it would have done had there been no snow fence. To be of value, snow fences should be placed at least 100 ft. from the track. However, with the powerful locomotives and the snow fighting equipment which we have today, snow is not the same menace it was years ago."

Mr. J. G. Gwyn, chief engineer of the Denver & Rio Grande R. R., advises that, "the type of snow fence built depends upon the locality in which such fence is to be erected. On some portions of the line we have in the past built the customary horizontal board snow fence, while in others, especially in the more mountainous districts, we have constructed high snow fences of poles after the old style zigzag rail fence. We have not been maintaining snow fences recently, as we are of the opinion that we are not justified in the cost of such maintenance. Of late years we have been in doubt as to the economic value of snow fences in the territory served by our line."

The committee believes that the nature of the country traversed by the Denver & Rio Grande makes the construction of snow fences very expensive and the mountainous character of much of this line makes the results very doubtful. We are of the opinion that a hilly, rolling or open country, generally free from vegetation, offers the greatest possibilities for the use of snow fences.

We recommend for general use a portable type of snow fence built of 1 in. by 6 in. by 16 ft. rough fencing lumber braced and nailed onto supports of 2 in. by 6 in. timbers. Such a fence stands about 7 ft. high and is built in 16 ft. panels. The bottoms of the supports are connected by a 2 in. by 6 in. by 8 ft. timber to brace them on the ground and to keep the supports spread. Hardwood stakes 3 in. by 3 in. in size or ⅞ in. round iron fastenings are used to anchor the fence to the ground and to prevent it from blowing over during high winds. Stone is also sometimes used when convenient. This fence is standard on the Oregon Short Line; the Chicago, Milwaukee & St. Paul; the Duluth & Iron Range, and the Union Pacific. The legs of this fence swing on a bolt located three boards below the top and are held apart by a 2 in. by 6 in. timber bolted at the bottom. This fence folds up so that it occupies a vertical space of only 8 in. when lying upon the ground or when loaded upon cars.

In erecting the fence a form is constructed for nailing up the panels and four active men will set up a panel ready for loading on cars, every four minutes. Where much fence of this type is to be erected, a work train is generally employed and the fence is unloaded from the cars as conveniently as possible. It is hauled from the car to its location on an ordinary lumber wagon fitted with a rack. Care should be taken to start the erecting of the fence early in the fall, say in September, so that work can be completed before bad weather comes and frost interferes with the driving of the stakes which hold the panels down.

The chairman of this committee has had much experience with snow fences during his service of over 20 years on the Union Pacific, and has had no fences other than of the portable type in use. However, the committee does not wish to be understood as recommending the portable pattern because it can be moved during the winter storms, as fence moved under those conditions will be damaged considerably. If necessary, we advise making and placing new fence after the original fences have become buried in the drifts. The economy of this practice will be evident when the fences are repaired the following season.

We find that it is customary to make a snow fence serve the purpose of a right of way or boundary fence in many instances. The conditions are exceptional where such a fence will provide the proper protection against snow and we recommend a careful study of local conditions, including the direction of prevailing winds and the lay of the land before placing fences anywhere.

Committee: A. H. King, Chairman; F. E. King, C. F. King, Frank Lee, C. S. McCully.

Discussion.

W. E. Alexander.—We have turned our snow fences over to the track forces. A tight board vertical fence 10 ft. high is the only kind we find successful.

TRACK SCALES.

A very complete and valuable report on track scales was presented by the committee, A. M. Van Auken, chairman. It was accepted with provisions for harmonizing it with the report of a similar committee of the American Railway Association.

PRESERVATION OF TIMBER.

Structural Advantages of Preserving Timber.

In many localities, the native woods would be suitable for piles and many other uses, if they were durable enough to make it pay to use them. The cost of this material treated is often less than that of more durable material brought from a distance and in all probability it will give longer service. Sound sap-wood is as strong as heart-wood but very much less durable and, unless the timber is treated, it should be excluded as far as possible in structures exposed to the weather. As sap-wood takes the treatment better than heart-wood, this is an advantage instead of a defect.

Treating the timber permits the use of smaller sizes for piles, poles, etc., as no allowance has to be made for decrease of size when sap-wood decays. Timber containing sap-wood is also cheaper, as there is less waste in cutting it from the tree. For railroad structures, such as bridges, trestles, docks, coal bunkers, etc., there is no doubt but that creosote is the best preservative in use at present.

The committee will not make any recommendation as to the process to be used, but advises that the treatment be such as to give the following results:

For piles and other parts of a structure, that come in contact with the soil, a full cell treatment should be given, injecting all the oil the timber will take. This is especially necessary in piles, on account of their liability to shatter or check in driving. For timber not in contact with the ground, a cheaper treatment may be advisable; but as deep a penetration as possible should be obtained, regardless of the quantity of creosote left in the timber.

Life of Treated Timber.

The next question that presents itself is how long can we expect creosoted material to last. It has been impossible to get figures from many railroads, so we will give the experience of the Southern Pacific only.

The Southern Pacific has in place, in trestles, about 105,000 creosoted Douglas fir piles, treated by the boiling process, ranging in age from one to 23 years with probably more than two-thirds of them over 12 years old. Of this great number not more than 500 have ever been replaced on account of decay and many of these piles 20 or more years old are as good as when driven. There is no doubt but these piles will be good for 30 years at least. The same timber would not have lasted eight years untreated. The number of decayed piles shown above is estimated and is considered to be above, rather than below, the actual number.

This same company has in service a number of untreated cedar piles that are 20 years old and are still sound. These piles cost about 15 cts. per ft. and the driving costs about the same, making the total cost 30 cts. per ft. If they are good for 25 yrs. they will cost 2.13 cents per year and if good for 30 yrs., 1.95 cents per ft. per year. Creosoted they would cost 50 cts, per ft. driven and would have to last about 45 to 60 yrs. to equal the cost of the cedar untreated.

Redwood piles are also very durable but they are no longer cheap. All redwood piles are cut from large trees and take the price of square timber.

The average price for trestle decks in place is about $40 per M. if untreated and $60 if creosoted. If the creosoted deck lasts 30 yrs. it will pay to creosote the decks in any locality where climatic conditions are such that the deck will not last over 14 yrs. untreated.

While it may not pay to give a pressure treatment to timber having a long life naturally, it may pay to give it some other kind of treatment. It is a fact that, although cedar and other durable piles have a long life, they decay in some parts more than in others. In some instances, decay starts at the head or top and in other cases at or near the ground line.

A good brush treatment of creosote can be given for three or four feet at the ground and the head thoroughly saturated for 30 to 40 cts. per pile. If the pile is of any great length this will represent a very small proportion of its cost, or only about the same as one foot of pile. This treatment may increase the life of the pile several years and one year's extra life would pay. Creosote applied in this manner should be used hot, at a temperature of about 180 to 200 deg. F.

Paints and Whitewashes.

Paints and whitewashes are often used as preservatives and are of great value as such, but they depend entirely on their waterproofing qualities for their efficiency. They are liable to crack and peel off and, if applied to unseasoned timber, cause dry rot. For this reason, timber should not be painted

until it is thoroughly dry and seasoned. As a rule timber structures should not be painted for a year after erection. It is doubtful if very large sizes of timber should ever be painted on all four sides.

Mineral oil also depends on its waterproofing qualities for its efficiency as a preserver, but has none of the faults of paint as it will not track or peel off. It does not close the pores and consequently does not cause dry rot. It may add to the fire hazard, but those oils that have an asphalt base do not add greatly to the risk.

Framing.

Whenever possible, all framing of timber should be done before treatment, even to the boring of holes, but it is very seldom that this can be done. On a trestle, the only framing absolutely necessary is to cut the piles to the right height and apply the braces. Stringers, ties, etc., can be framed and treated before going to the job, but this requires a refinement of workmanship not easily attained in this generation.

Braces should be fittted to the piles and in no case should the skin of the pile be cut. Piles should be selected so all in one bent would be of approximately the same size and any large protrusions on the piles should be cut off before treatment.

No satisfactory method of treating horizontal bolt holes has been developed. It is not practical to fill the holes with creosote. It may be said that twenty years' experience with such work has not shown the necessity of treating them in any way, but where the piles are in water that varies in height, some treatment may be necessary. Experiments might be made by boring the holes a trifle small and burning them to size as the charring of the wood might help. However, if the bolts are kept tight there will be little trouble. In such cases it would probably be best to spike the braces on with boat spikes.

In most cases it does not pay to creosote braces and girts as they have a reasonably long life and are easily replaced. There is also a considerable amount of framing to be done on them and this would to some extent impair the value of the creosote. A good brush treatment with creosote after framing or, better, a good soaking in a tank of hot creosote is probably as good as a pressure treatment for girts and braces if they are of the usual small sizes.

As a rule, we would recommend the use of piles of cedar or cypress, untreated or with a brush coat at the ground line, wherever they can be obtained at a price of about 60 per cent that of creosoted material. We would recommend creosoted piles of the cheapest available material for all structures that are expected to be in use ten or more years, where cedar, cypress or white oak cannot be obtained at a favorable price. We do not recommend the use of creosoted material for caps, braces, stringers and ties of open deck trestles, but do recommend it for all parts of ballasted deck trestles. The above recommendations are to be considered as general and are not intended to apply to localities where untreated material has a very short life.

Where framed bents are used on a pile foundation, the piles should be cut off high enough to keep the sill of the bent clear of the ground (the higher the better). The question of preserving the material will depend on the cost of material and its economy in yearly cost, giving the preference to preserved material on account of the lessened delays to traffic due to reconstruction.

Marine Borers.

Along the sea coasts the timber in marine structures is subject to the attacks of wood borers, commonly known as shipworms and wood lice. The worms are either Xylotrya or Teredos, these mollusks being much alike in structure and mode of life. The Xylotrya are more abundant in the waters of the United States and thrive best in the warmer waters, although they are found all along the coast. They are not active near the mouths of large rivers where the amount of salt is influenced by the inflow of fresh water.

There being no way to destroy the borers, it is necessary to protect the timber in some way to prevent or retard their attacks and the following methods have been used:

1. Use piles with bark on. The borers will not attack piles with the bark on and this is one of the best methods to use, but as a very small exposed surface will permit of their attacks, care must be taken to keep the bark intact while handling and driving. Where boats tie up to a wharf or where much drift is afloat it is impossible to keep the bark on. However, all piles driven in water infested by borers should have the bark on, unless given other treatment.

2. Use an artificial bark of sheathing. This method has the same advantages as natural bark and practically the same disadvantages.

3. Insert flat-headed nails to completely cover the parts of pile exposed to attacks. This method is very expensive and unless copper or galvanized nails are used they soon corrode and fall off.

4. Cover the exposed surface with fabrics saturated with tar or asphalt or mixtures containing them. This method is good while it lasts, but it will not last long in rough water or where boats or drift come in contact with it.

5. Cover the piles with copper, zinc or other metal sheathings. Copper and zinc are good, but expensive and are liable to be removed by thieves. Iron has to be thick to resist corrosion and is expensive.

6. Cover the piles with a cement coating, either before or after driving. In using this method it is customary to place wire netting around the pile with one to two inches of cement mortar, either applied as a plaster or by using a form and casting it. This method has been used with good success on tide lands where the mud is exposed at low tide and has also been used to protect and reinforce piles which have been partially destroyed. While liable to be broken off by drift, etc., it is easily replaced and can be recommended for such locations.

Fence Posts.

Fences are a great expense to railroads and satisfactory material for posts is difficult to secure. White oak, cedar and redwood are the most suitable varieties for posts and have a fairly long life as such. As they almost always rot off at the ground, it might pay to give the oak and cedar a butt treatment, but such is not necessary for redwood, which will probably be good for 40 years. The timber is somewhat scarce and of course is only cut in California. Oak and cedar are also becoming scarce and some substitute will have to be provided. Concrete and iron posts are satisfactory but expensive, and the real solution of the difficulty is in the use of any wood that may be available, treating it to prevent decay.

Practically all varieties of timber will give good service as posts if that part that goes in the ground and for about six inches above the ground is treated with preservative; but water oak, maple, sycamore, cottonwood, quaking aspen and possibly others should be treated full length, as they decay rapidly above ground as well as below. A brush treatment is of some value but dipping the post in the preservative is better, as the checks and cracks are more likely to be filled. However, such treatment is only superficial and the results will not be as satisfactory as they would be if a more thorough impregnation is given. The open tank method of treatment is probably best for posts as the plant does not cost a great deal and it can be moved from place to place easily.

Wood Block Floors.

One of the best floors for shops and roundhouses is made of wood blocks, but the length of life is short unless they are treated with preservative. The blocks can be made of almost any kind of timber, but the closer grained pines and firs probably are best. They should be about 4 in. by 8 in. in size, from 3 in. to 5 in. long, and should be set with the end grain up. A light treatment of preservative is all that is required for floors in buildings, and as the blocks have such a large surface in proportion to their volume, they are easily treated

by the non-pressure or open tank process, using creosote, carbolineum and similar preservatives.

Effect of Treatment on Strength of Timber.

The following conclusions on the effect of preservatives on the strength of timber are the results of experiments by the United States Forest Service:

1. A high temperature of steaming is injurious to the wood in strength and spike holding power. The degree of steaming at which pronounced harm results will depend upon the quality of the wood and its degree of seasoning, and upon the pressure (temperature) of steam and the duration of its application.

2. The presence of zinc chloride will not weaken timber under static loading, although the indications are that the wood becomes brittle after impact.

3. The presence of creosote will not weaken wood of itself. Since apparently it is present only in the openings of the cells, and does not get into the cell walls, its action can only be to retard the seasoning of wood.

FIRE RESISTING COATING FOR TIMBER.

This report sets forth the results of tests made on various commercial fire resisting coatings for timber bridges. The method of procedure was as follows:

In the summer and fall of 1912, several small test structures were erected and the timber placed same as is done on regular pile bridges, so as to have practically the same conditions as regards applying the paint and withstanding the fire, as would be obtained in actual practice.

A different make of fire resisting coating was applied to each structure shortly after all of them were erected. These structures, with the coating applied, were allowed to stand during the winter until June 28, 1913, at which time the fire test was applied.

The fire test consisted of placing a considerable amount of hay on and around each structure and igniting it. The question might be raised that possibly this was rather a severe test and something that would seldom occur in actual experience. However, it is possible for such a condition to exist and furthermore, all the specimens were subjected to the same test, so that comparative results were obtained.

In the following descriptions of the different coatings and statement of how each one stood the fire test, each coating is referred to by number, rather than by giving the maker's name.

Description of the Coatings.

No. 1. This article is prepared for application by mixing with water in proportions of three and one. It is then heated and applied with a brush. It is easily applied, requiring one man two and one-quarter hours to give the test structure one coat. When the fire test was applied there was a very strong fire lasting two minutes and ten seconds, when the flames died down considerably. The timber continued to burn, however, and after a period of thirteen minutes had elapsed, the timber was damaged and considerably weakened.

No. 2. This is a very thick substance and hard to apply. It could not be brushed readily and it was found that the best way to apply it was to put it on in small patches. When dry it forms a hard coat on the timber and the appearance is similar to timber which has been painted and sanded. It required one man twelve hours to apply this coating to one of the test structures. This article is of a white color. When the test was applied flames rose up rapidly at first and died down in two minutes and thirty seconds. The timber continued to burn, however, and eighteen minutes after starting there was very little fire around the timber. This specimen appears to be a fairly good fire resisting coating but the labor of applying it would be rather expensive.

No. 3. This is a heavy oil paint and easy to apply. It required one man six hours to apply one coat to the structure. When the test was made the flames rose rapidly but died down in two minutes and forty-five seconds, when the timber continued to burn slowly. It is very evident that this article offered some resistance to the fire.

No. 4. This article is applied in two coats, each a different material. The first is a cold water paint and the second an oil paint. It required one man six hours to apply the first coat and four hours to apply the second, making a total of ten hours for the two coats. A day or two after the structure was painted with this material, most of the second coat was washed off by rain, and, therefore, another second coat was applied, making three coats in all. When the test was applied the flames rose rapidly and died down in one minute and thirty seconds. It continued to burn slowly but after a period of five minutes and forty-five seconds the flames died down entirely. It was thought that on account of the extra second coat which was applied to this structure that we were giving it an undue advantage and in order to compensate for this we decided to apply a second fire test to this structure, which was done. The results were practically the same as at first except that a period of seven minutes elapsed before the flames died out. This article withstood the test remarkably well.

No. 5. This is a thin oil paint. It is easily applied. Specifications call for two coats. It required one man four hours to apply the first coat and four hours to apply the second. It is of a black color. When the test was applied flames arose rapidly and died down in two minutes and thirty seconds. It continued to burn very slowly and appeared to offer considerable resistance to the fire.

No. 6. This is a thick black oil paint and to prepare it for application it is heated to just below the boiling point and kept at this temperature while applying. It required one man four and one-half hours to apply one coat. When the test was applied flames rose rapidly and then died down in two minutes and forty-five seconds. After about eight and one-half minutes it was seen that the timber was burning in such a way as to eventually destroy the structure.

No. 7. This is a cold water paint and works easily. It is of a white color. It required one man five hours to apply one coat. When the test was made flames rose rapidly and died down inside of four minutes. It continued to burn, however, and six and one-half minutes after starting it was found that the timber was burning rapidly.

No. 8. This is a thick black paint and in preparing it for application it is heated to just below the boiling point and kept at that temperature while being applied. It works easily and required one man six hours to apply one coat. When the test was applied flames rose rapidly and died down in two minutes. It continued to burn, however, and after six minutes it was seen that the timber was afire in such a way as to eventually destroy the structure.

No. 9. This is a thin oil paint. Specifications call for two coats. It is of a black color. It required one man four hours to apply the first coat and two hours to apply the second. When the test was applied flames rose rapidly and died down in five minutes but continued to burn quite rapidly in such a way as to ultimately destroy the structure. Very little fire resistance was shown.

No. 10. This is a thick black paint, heated before applying and kept just below the boiling point while being applied. It required one man five hours to apply one coat. When the test was applied flames rose rapidly and died down inside of five minutes. It continued to burn, however, in such a way as to gradually destroy the timber.

It will be noted that in describing the test in each case we make the statement that the flames rose rapidly and then died down within a certain time. Naturally, when the fire was applied to the hay, the flames shot up quickly, after which the fire settled to a steady burn. The time elapsed in doing this was taken in each case and is what is meant in the statement, "The flames died down in such a time."

The weather conditions were quite favorable at the time

tests were made, it being clear and bright and the thermometer standing at about 95 degrees.

From this test it is apparent that, with the possible exception of one coating, none of them could be called fire proof. But practically all of them were fire resisting to a certain extent. Specimen No. 4 seemed to give the best results because it was fired twice and each time the flames died down entirely. In all other cases the fire gradually found its way into the timber so that if nothing were done to extinguish it, it would gradually destroy the structure. All of these coatings would, however, be of some value as a fire retardent.

As stated above, specimen No. 4 proved to be the best. The committee decided that the others ranked in the following order: 6, 8, 2, 5, 10, 9, 3, 1 and 7.

The committee has reached the conclusion that there is no coating on the market which is absolutely fire proof, but that there are several which would be of considerable value in case it is desired to protect a structure which is located in such a way as to be in danger of fire. Such a structure naturally would be closely watched, and in case of fire, a good resisting coating would retard the flames for a considerable time until some one could reach the location and extinguish the fire.

Discussion.

J. S. Robinson.—The final result was that all bridges in the test burned. We often have conditions at bridges no worse than those in the tests. The most rotten parts of the timber, which absorbed more of the paints, burned last.

All the paints stood the live coal test, and a resolution was presented stating that fire-resisting paints on tops of structures will resist fire from engine coals.

ELECTION OF OFFICERS.

Los Angeles was selected as the meeting point for the next convention. The following officers were elected:

President, J. N. Penwell, supervisor of bridges and buildings, Lake Erie & Western R. R.; first vice-president, L. D. Hadwen, engineer of masonry construction, Chicago, Milwaukee & St. Paul Ry.; second vice-president, G. Aldrich, bridge supervisor, New York, New Haven & Hartford, R. R.; third vice-president, G. W. Rear, general inspector, Southern Pacific, Co.; fourth vice-president, C. E. Smith, assistant chief engineer, Missouri Pacific Ry.; secretary, C. A. Lichty, general inspector, Chicago & North Western Ry.; treasurer, J. P. Canty, supervisor of bridges and buildings, Boston & Maine R. R.; members of executive committee, W. F. Strouse, assistant engineer, Baltimore & Ohio R. R., and C. R. Knowles, general foreman water works, Illinois Central R. R.

WANTED.

"The great want of the world is men; men who are not for sale; men who are honest, sound from center to circumference, true to the heart's core; men who fear the Lord and covetousness; men who will condemn wrong in friend or foe, in themselves as well as in others; men whose consciences are as steady as the needle to the pole; men who will stand for the right if the heavens totter and earth reels; men who will tell the truth and look the world and the devil right in the eye; men who neither brag nor run; men who neither swagger nor flinch; men who have courage without whistling for it and joy without shouting to bring it; men in whom the current of everlasting life runs still and deep and strong; men careful of God's honor and careless of man's applause; men too large for sectarianism and too strong for political cabals; men who do not strive nor cry, nor cause their voices to be heard in the streets, but who will not fail nor be discouraged till judgment is set on earth; men who know their message and tell it; men who know their duty and do it; men who know their place and fill it; men who mind their own business; men who will not lie; men who are not too lazy to work nor too proud to be poor; men who are willing to eat what they have earned and wear what they have paid for.

Twenty Years Ago This Month

Twenty years ago this month the Belt Line tunnel under the city of Baltimore was completed with the exception of the north approach. This tunnel connects the Baltimore & Ohio proper with the Philadelphia division.

Enoch Lewis, purchasing agent of the Pennsylvania, terminated his forty-three years of service by tendering his resignation to take effect November 30, 1893.

The first trial of electricity, transmitted by means of the trolley system, for the propulsion of boats operating on the Erie Canal, was conducted by the Westinghouse Electric & Mfg. Co., and the Niagara Falls Power Co., Nov. 18, 1893. It may be added that the New York Tribune, in its account of the test, stated that the boat "was pushed by two trolley poles instead of one as are ordinary street cars."

During November, 1893, the railways which had reduced wages temporarily during the depression, either restored them or made promises as to their early restoration. The manufacturers for the most part placed their shops back on full time following the retrenchment.

One of the most notable of railway excursions was the trip of two trains made up of World's Fair exhibits of equipment, from Chicago to the East over the Lake Shore and the New York Central. One of the trains consisted of the famous 999 hauling the five elaborate Wagner exhibition sleepers, and two flat cars on which were loaded the three small cars which composed the first train of the New York Central Ry., run in 1831. The second special train was made up of two English sleepers of the London & Northwestern Ry., two Wagner sleepers and a diner, and was hauled by the London & Northwestern three-cylinder Webb compound. These trains were operated only in the daytime, making inspection stops at each large city along the route.

Wm. McGrafton, signal engineer of the Pennsylvania Lines west of Pittsburgh was held up and shot November 27, 1893, near his home at Sewickley, Pa. A package of letters intercepted the bullet and prevented fatal injury.

Theodore Voorhees*, M. Am. Soc. C. E., was appointed general manager of the Lehigh Valley.

L. C. Fritch† was appointed division engineer on the Baltimore & Ohio Southwestern.

Victor K. Hendricks‡ was appointed assistant engineer of the Vandalia.

Bion J. Arnold, who had charge of the International Railway of the World's Fair, opened a consulting engineer's office in the Rookery, Chicago.

The car repair barns of the Armour Car Lines at 45th street, Chicago, were destroyed by fire recently. Sixteen refrigerator cars were in the barns at the time. The loss is said to have been about $50,000.

The Baltimore & Ohio has placed a contract for paving, concreting and waterproofing the Lee street bridge, in South Baltimore. This is part of the program of grade crossing elimination which the company has under way.

The Canadian Pacific has let a contract to John S. Metcalf Co., Limited, Montreal, for an extension of the Glen arch at Westmount, Montreal, which will cost $50,000.

The Chicago, Milwaukee & St. Paul will expend $40,000 in rebuilding its coal handling plant and roundhouses at North LaCrosse, Wis.

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*Now Vice-president Philadelphia & Reading.
†Now Chief Engineer, Chicago Great Western.
‡Now Principal Assistant Engineer, St. Louis & San Francisco.

Personals

Operating

Although we are publishing monthly in these columns a practically complete report of all appointments of interest to our readers, it is probable that this information could be published earlier if each subscriber would make it his business to notify us of new appointments immediately. We request and we shall appreciate your assistance in this respect.

James D. Tyter, formerly superintendent, has been appointed general superintendent of the *Boston & Maine R. R.*, office at Boston, Mass. F. H. Flynn, formerly trainmaster, has been appointed superintendent at Boston, succeeding Mr. Tyter. G. H. Folger has been appointed superintendent at Boston, succeeding J. F. Piper, on leave of absence.

E. J. Devans has been appointed general superintendent of the *Buffalo, Rochester & Pittsburgh Ry.*, office at Rochester, N. Y. He

E. J. BEVANS, General Superintendent
Buffalo, Rochester & Pittsburgh Ry.

was born in 1867 at Medina, N. Y., educated in the public schools, and entered railway service in May, 1883, as telegraph operator with the New York Central, and worked successively with the New York Central, D. L. & W., W. N. Y. & P., and West Shore railroads as telegraph operator and agent until 1888. He entered the service of the B. R. & P. Ry. as operator and agent in October, 1888, was transferred to superintendent's office as clerk in September, 1889, and in April, 1893, was transferred to copier in the train dispatchers' office; he was appointed train dispatcher in August, 1893, and chief dispatcher, with duties of trainmaster, in September, 1899. He served as special representative to the general manager from May, 1905, to March, 1907, and was appointed superintendent of Rochester and Buffalo divisions in March, 1907, and general superintendent October 1, 1913. This position had been vacant for the past two years, the duties of both positions being looked after by Mr. T. F. Brennan, general manager.

M. G. McInerney, formerly assistant superintendent of the *Buffalo, Rochester & Pittsburgh Ry.* at Rochester, has been appointed superintendent of the Buffalo and Rochester divisions, office at Rochester, N. Y. He succeeds E. J. Devans, promoted.

C. A. Cottrell has been appointed superintendent of the British Columbia division of the *Canadian Pacific Ry.* at Vancouver, B. C., succeeding G. E. Graham, resigned. R. W. McCormick has been appointed superintendent of the Eastern division at Montreal, Que., succeeding A. L. Smith. C. S. Maharg has been appointed superintendent of the Manitoba division at Brandon, Man., succeeding J. A. MacGregor, on leave of absence. A. L. Smith, formerly superintendent on the Eastern division, has been appointed superintendent of district No. 1, Lake Superior division, office at Sudbury, Ont. He succeeds George Spencer, appointed chief operating officer, western lines, Board of Railway Commissioners, Ottawa, Ont.

R. F. Armstrong, formerly assistant superintendent, has been appointed superintendent of the *Chicago & North-Western Ry.* at Mason City, Ia., succeeding H. Rettinghouse, appointed chief engineer of the Soo Line.

W. B. Causey, formerly superintendent of the *Chicago Great Western R. R.* at Des Moines, Ia., has been appointed superintendent at St. Paul, Minn., succeeding C. E. Carson, resigned. C. A. Shoemaker, formerly assistant superintendent, has been appointed superintendent at Des Moines, Ia., succeeding Mr. Causey. J. M. Clifford has been appointed superintendent at Green Bay, Wis., succeeding E. K. Hastings, retired.

T. J. Hayes has been appointed acting superintendent of the *Cleveland, Cincinnati, Chicago & St. Louis Ry.* at Wabash, Ind. He succeeds C. S. Millard, appointed acting superintendent at Indianapolis, Ind., in place of D. F. Schaff, on leave of absence.

J. R. HALLIDAY, Asst. to General Manager
New York, New Haven & Hartford R. R.

P. F. Keating, formerly trainmaster, has been appointed superintendent of the *Great Northern Ry.* at Sioux City, Ia. He succeeds G. E. Votaw, appointed superintendent at Breckinridge, Minn., in place of F. D. Kelsey, appointed superintendent at Great Falls, Mont., succeeding P. C. Allen, resigned.

W. W. Harwood has been appointed secretary of the *Madison County Ry.*, office at Stackhouse, N. C., succeeding A. A. McQuide.

George S. Hobbs, formerly general manager, has been appointed vice president of the *Maine Central R. R.*, office at Portland, Me.

D. C. Douglas has been appointed general manager of the *Maine Central R. R.*, office at Portland, Me., succeeding G. S. Hobbs, promoted. He was born February 2, 1877, in Leeds, Me., entered railroad service in July, 1894, and was employed until November 10, 1897, as stenographer in the passenger traffic department and for the general manager, Maine Central R. R.; from November, 1897, to February 15, 1910, he was secretary to general manager, and vice president and general manager; February 15, 1910, to July 10, 1913, he was assistant to vice president and general manager, and July 10 to October 15, 1913, assistant to the president. October 15, 1913, he was appointed general manager of the Maine Central R. R. and the Portland Terminal Co., as noted above.

P. B. Smith has been appointed superintendent of the *Minnesota, Dakota & Western Ry.*, office at International Falls, Minn., succeeding W. J. Shreve, appointed master mechanic.

The general offices of the *Missouri & North Arkansas R. R.* have been moved from Leslie to Harrison, Ark. The following

officials are now located at Harrison: E. M. Wise, general manager; W. H. De Witt, superintendent; and E. Falkner, car accountant.

M. J. Wise has been appointed assistant to general manager of the *Mobile & Ohio R. R.*, office at Mobile, Ala. He was born August 16, 1883, in St. Louis, Mo., educated in the public schools and entered railway service, January 11, 1901, as clerk, claim and rate departments, Mobile & Ohio R. R., since which he has been consecutively December, 1901, to April, 1903, clerk in general manager's office; April, 1903, to March, 1907, secretary to general manager; March to December, 1907, chief clerk to superintendent of transportation; December, 1907, to March, 1911, chief clerk to general manager same road; March, 1911, to October, 1913, superintendent, Southern Ry. His appointment, noted above, was effective October 15.

F. Pescador has been appointed superintendent of the *National Rys. of Mexico* at Durango, Dgo., Mex., succeeding S. Cantu. V. E. Palacios has been appointed superintendent at Jalapa, V. C., succeeding C. W. Rowe.

J. R. Halliday has been appointed assistant to general manager of the *New York, New Haven & Hartford R. R.*, office at New Haven, Conn. He began railroad work in 1887, and from that time

C. W. NELSON, Asst. to President St. Louis, South Western Ry.

until 1893 served in various capacities in telegraph and station service with the C. & O., N. & W., B. & O. and N. Y. C. In 1893 he entered the service of the New Haven in telegraph service and served in various capacities until 1908, when he was appointed master of transportation, holding the latter position at the time of his appointment as assistant to general manager.

J. O. Droege, formerly superintendent, has been appointed general superintendent of the *New York, New Haven & Hartford R. R.*, office at New Haven, Conn. W. H. Foster, formerly superintendent at Taunton, has been appointed superintendent at New Haven, Conn., succeeding Mr. Droege. C. H. Motsett, formerly trainmaster, has been appointed superintendent at Harlem River, N. Y. H. C. Oviatt has been appointed superintendent at Taunton, Mass., succeeding Mr. Foster.

B. E. Palmer has been appointed superintendent of the *Oregon-Washington R. R. & Navigation Co.* at Portland, Ore., succeeding J. D. Stack.

C. W. Nelson, formerly assistant general manager, has been appointed assistant to president of the *St. Louis Southwestern Ry.*, office at St. Louis, Mo.

E. E. McClellan has been appointed general superintendent of the *San Benito & Rio Grande Valley Ry.* at San Benito, Tex., succeeding E. S. Heyser.

G. N. Howson, formerly master mechanic, has been appointed superintendent of the *Southern Ry.* at Louisville, Ky., succeeding F. W. Brown, resigned.

C. H. Fox has been appointed superintendent of the *Sumpter Valley Ry.*, office at Baker, Ore.

F. W. Kane, formerly office engineer, has been appointed assistant chief engineer of the *Texas & Pacific Ry.*, office at Dallas, Tex.

Engineering

J. A. Donahey has been appointed superintendent and chief engineer of the *Akron, Canton & Youngstown Ry.*, office at Akron, O.

J. W. Orrock, formerly division engineer, has been appointed principal assistant engineer of the *Canadian Pacific Ry.*, office at Montreal, Que. J. E. Beatty, formerly assistant engineer of construction, has been appointed division engineer at Montreal, Que.

D. Hillman has been appointed division engineer of the Lake Superior division of the *Canadian Pacific Ry.* He entered the service of this company in 1901 as chainman, and after holding various positions on location and construction, he was appointed assistant engineer in 1905, and had charge of surveying parties or construction until 1912, on which date he was appointed assistant engineer of construction, Lake Superior division, the work involved being double tracking from Sudbury to Port Arthur, 55 miles. He held the latter position until his present appointment as division engineer.

S. Bruce McConnell, A. M. Can. Soc. C. E., was appointed division engineer, Lake Superior Division, *Canadian Pacific Ry.*, July 1, 1913, with headquarters at North Bay, Ont. He first entered railway engineering in January, 1898, as transitman on location for the Atlantic & Lake Superior Ry., and since then he has held the following positions: April, 1898, transitman on location, and May of the same year, appointed resident engineer on construction for the Midland Ry.; April, 1890, transitman on location and July of the same year appointed resident engineer on construction for the Great Northern Ry.; 1900, assistant engineer on water power development, Sturgeon Falls, Ont., Cornwall, Ont., and Upper Saguenay River, Que.; January, 1901, resident engineer on construction for the Cuba Ry., Santa Clara, Cuba; January, 1902, locating engineer for the South Shore Ry., Quebec; June, 1902, assistant engineer, in charge of yard construction, North Bay, Ont.; July, 1902, resident engineer, Montreal; January, 1910, assistant division engineer, Eastern division, C. P. Ry., Montreal; November, 1912, assistant engineer, eastern lines, Montreal, holding the latter position till his appointment as division engineer.

C. D. MacKintosh has been appointed division engineer of the Saskatchewan division of the *Canadian Pacific Ry.*, at Moose Jaw, Sask., effective Sept. 1. J. M. Campbell has been appointed resident engineer of the Manitoba division at Kenora, Ont., succeeding S. C. Wilcox. D. M. Ewart has been appointed resident engineer of the Ontario division at West Toronto, Ont., succeeding F. M. Rutter. J. H. Reeder has been appointed resident engineer of the Lake Superior division at Chapleau, Ont., succeeding S. W. Shackwell. D. A. Wallace has been appointed resident engineer of the Eastern division at Farnham, Que., succeeding F. T. Ruhl.

F. B. Walker, who has been appointed assistant engineer of the *Chicago, Milwaukee & St. Paul Ry.*, at Lewistown, Mont., as announced previously, graduated from Purdue University in 1905, College of Engineering. He entered the service of the C. M. & St. P. Ry., in July, 1905, as instrument man in the bridge and building department, and was made assistant engineer in charge of concrete work on line in Iowa and a portion of South Dakota in November, 1905. He left the service of the C. M. & St. P. Ry., in November, 1911, to become chief engineer of the Arizona Land & Irrigation Co., at Prescott, Arizona, where he remained until June, 1913, and then returned to the C. M. & St. P. Ry., as acting engineer of masonry construction. September 20, 1913, he was appointed assistant engineer in charge of the bridge, building and

concrete work on the new Lewistown-Great Falls Line of the C. M. & St. P. Ry., with office at Lewistown, Montana.

C. W. Johnson, formerly chief engineer of the *Chicago, St. Paul, Minneapolis & Omaha Ry.*, has been appointed consulting engineer, his office remaining at St. Paul, Minn. H. Rettinghouse, formerly superintendent of the Chicago & Northwestern Ry., has been appointed chief engineer, succeeding Mr. Johnson, office at St. Paul, Minn.

F. M. Thomson has been appointed assistant engineer of the *Houston & Texas Central R. R.*, at Ennis, Tex.

T. C. Burpee, formerly engineer maintenance of way, has been appointed superintending engineer of the *Intercolonial Ry.*, office at Moncton, N. B. H. McM. Killaly has been appointed engineer of construction, office at Moncton, N. B. W. R. Devenish has been appointed division engineer, office at Moncton, N. B. L. Brousseau has been appointed resident engineer at Levis, P. Q. H. T. Ruhl has been appointed resident engineer at New Glasgow, N. S.

W. A. Duff has been appointed engineer of bridges of the *Intercolonial Ry.*, office at Moncton, N. B.

Mr. Robert A. Klock, who was on the first of September, 1913, appointed general tie and timber agent of the *Intercolonial Ry.*, with headquarters at Moncton, N. B., was born at Aylmer, Que., near Ottawa. Mr. Klock received his education at the common school of his native town, from which he entered the Collegiate Institute at Ottawa. He afterwards graduated in Arts from McGill University, Montreal. Some time after, he took a short military course at Kingston, Ont. Entering into the lumber business with his father and brother, James B. Klock, ex M. P., he received a knowledge of the timber trade in all its details. He subsequently was employed by the Canadian Pacific Ry., and was for several years chief tie and timber inspector on the Atlantic division, with headquarters at St. John, N. B. He was employed by the Canadian Government to inspect and ship hard pine dimension timber from Louisiana and Texas for the government docks at Port Nelson, Hudson's Bay.

R. M. Leeds has been appointed assistant engineer of the *Louisville & Nashville R. R.*, at Evansville, Ind., succeeding G. D. Hill, resigned to accept a position with the Illinois Central R. R.

C. E. Bandelin has been appointed vice president and chief engineer of the *Madison County Ry.*, office at Hot Springs, N. C., succeeding W. N. Garrett.

E. A. Whitman, formerly assistant engineer, has been appointed valuation engineer of the *Minneapolis, St. Paul & Sault Ste. Marie R. R.*, office at Minneapolis, Minn.

The general offices of the *Missouri & North Arkansas R. R.* have been moved, and W. O. Galbreath, engineer maintenance of way, is now located at Harrison, Ark.

J. R. Stephens, chief engineer of the *Missouri Pacific Ry.*, has been appointed chairman of the valuation committee, his office remaining at St. Louis, Mo. J. A. Pritchett has been appointed right of way agent, office at St. Louis, Mo.

As previously announced, A. J. Himes has been appointed valuation engineer of the *New York, Chicago & St. Louis R. R.*, office at Cleveland, O. He is a Cornell graduate and went with the Nickel Plate as bridge engineer in 1901. After the reconstruction of the iron bridges he held the position of assistant chief engineer for two years, until the organization of the grade elimination department in 1909. He then became the head of that department and had full charge of the elimination of grade crossings in Cleveland and East Cleveland where twenty-nine such crossings were eliminated in a distance of five and one half miles. There has been a temporary cessation of that work and he will now give his attention to the valuation work.

W. E. Guignon has been appointed assistant engineer of the *Pennsylvania Lines West* at Chicago.

E. S. Heyser has been appointed division engineer of the *St. Louis, Brownsville & Mexico Ry.* at Kingsville, Tex.

The general engineering offices of the *Seaboard Air Line Ry.* have been moved from Portsmouth, the following officials now being located at Norfolk, Va.: W. D. Faucette, chief engineer; E. A. Frink, bridge engineer; E. C. Bagwell, assistant engineer; R. M. Coburn, assistant engineer; E. W. Smith, assistant engineer; and R. B. Gandy, division engineer.

R. J. McComb, formerly division engineer, has been appointed engineer maintenance of way of the *Wheeling & Lake Erie R. R.*, office at Canton, O. S. S. Senter, formerly division engineer, has been appointed engineer of construction, office at Canton, O.

Bridges and Buildings

The headquarters of W. C. Whitney, supervisor of bridges and buildings of the *Boston & Albany R. R.*, have been moved from Boston to Worcester, Mass.

J. W. Johnston has been appointed bridge and building master of the Ontario division of the *Canadian Pacific Ry.* at Toronto, Ont., succeeding L. L. Ross.

C. E. Powell, formerly general inspector of bridges and buildings of the *Chesapeake & Ohio Ry.* at Richmond, Va., has been appointed to a similar position at Covington.

F. A. Halle has been appointed bridge and building master of the *Intercolonial Ry.* at Chaudierre Jct., P. Q. W. P. Mills has been appointed bridge and building master at Sydney, C. B. E. Savage has been appointed bridge and building master at New Castle, N. B. D. A. Seaman, formerly carpenter foreman, has been appointed bridge and building master at Moncton, N. B.

B. E. Humes has been temporarily appointed assistant superintendent of bridges and buildings of the *Louisville & Nashville R. R.* at La Grange, Ky.

W. F. Rankin has been appointed master carpenter of the *Pennsylvania Lines West* at Cambridge, O., succeeding J. Wallenfelz, appointed bridge inspector at Cambridge, O.

J. J. McDonald, formerly master carpenter, has been promoted to supervisor of track and structures of the *Seaboard Air Line Ry.* at Savannah, Ga. H. L. Hatcher has been appointed master carpenter at Americus, Ga., succeeding Mr. McDonald.

Obituary.

W. C. Smith, chief engineer of maintenance of way of the *Northern Pacific Ry.*, died at his residence in Saint Paul on August 26, after a lingering illness. Mr. Smith was born in St. Cloud, Minnesota, July 30, 1865. He graduated from the University of Minnesota, department of civil engineering, in June, 1890, and entered the service of the St. Paul & Northern Pacific Ry., at Saint Paul, as assistant engineer, remaining with that company until 1903, when he was made assistant engineer of the Northern Pacific Ry. at Duluth, Minnesota. During the next nine years he continued as assistant engineer in charge of maintenance and construction work at various points. On March 1, 1902, he was promoted to division engineer, with headquarters at Livingston, Montana, and on December 1 of the same years he was transferred to St. Paul as division engineer in charge of engineering on all lines east of the Missouri River. On March 7, 1907, he was promoted to engineer of maintenance at Saint Paul, and on February 7, 1910, he was again promoted to be chief engineer of maintenance of way in charge of all maintenance engineering on the entire system. He was taken seriously ill in January, 1912, and although again resuming his duties in April of that year, he did not fully recover his health. His trouble became very serious in March of the present year, confining him to his bed from that time to the date of his death. Throughout this long period of suffering he showed the same cheerful, manly fortitude that had endeared him to his friends and associates during his twenty years of service with the Northern Pacific. His ability as an engineer was recognized by all familiar with his work and by his competent and tactful administration of his various offices he held the respect and friendship of both his superiors and subordinates in the railway service.

Correction.

An error was made in our October issue in announcing that M. A. Zook was appointed valuation engineer of the *Grand Trunk Ry.* Mr. Zook is merely doing some local valuation work at Buffalo.

The Engineer's Distress

A.S.Gunn Editor

Who's Got a Job for the Panama Gang?

by Berton Braley, in Colliers

YES ITS ABOUT TIME I WAS GETTING BACK HOME

THE GUY THAT PUT THE "PAN" IN PANAMA.

Here we are, gentlemen; here's the whole gang of us.
Pretty near through with the job we are on;
Size up our work—it will give you the hang of us—
South to Balboa and North to Colon.
Yes, the canal is our letter of reference;
Look at Culebra and glance at Gatun;
What can we do for you—got any preference,
Wireless to Saturn or bridge to the moon?

Don't send us back to a life that is flat again,
We who have shattered a continents spine;
Office work—Lord, but we couldn't do that again!
Haven't you something that's more in our line?
Got any river they say isn't crossable?
Got any mountains that can't be cut through?
We specialize in the wholly impossible,
Doing things "nobody ever could do!"

SHTAIM SHOVELS DID THE WURRK HERE, BUT MANY'S THE JOB THAT WAS DONE BY A NUMBER 2.

THE M.D. THAT GOT HIS START IN "LANSING MICHIGAN"

Take a good look at the whole husky crew of us,
Engineers, doctors and steam-shovel men:
Taken together you'll find quite a few of us
Soon to be ready for trouble again.
Bronzed by the tropical sun that is blistery,
Chuckful of energy, vigor and tang.
Trained by a task that's the biggest in history,
Who has a job for this Panama gang?

YASSR ISE IS THE GINK THAT PUT THE "COAL" IN COLON

'I GUESS IT'S ME BACK TO THE OLD HOOK & I' OR STARVE.

A.S.GUNN.

Concreting in Cold Weather

The time of the year is now at hand when the nights become cold even though the days are comparatively warm and oftentimes an unexpected frost will damage concrete just poured, because it sets slowly under such weather conditions. If concreting is done in winter proper provision is made to heat the materials so as to prevent freezing before the concrete has attained its final set. In the late fall, however, the conditions are different, the sole ambition of the contractor or man in charge of the work being to complete the job without having to incur the extra expense of a plant or outfit for heating materials, and for this reason some of the work is very likely to be spoiled by freezing. In this latitude, all apparatus for heating materials should be ready for use any time after the first of November; if not, a cold spell of a few days duration may seriously delay work or damage the concrete placed during that period.

The "Safety First" crusade now being carried on extensively by various railways to minimize the number of accidents, could be applied to the field of concrete work very beneficially, as regards the concrete itself. All men in charge of railroad concrete work should be instructed at this time of the year not to take any *chances on the weather* and to be prepared for the worst sort of weather at any time.

The cement companies have entered into this campaign very extensively, realizing that much of their success depends on the exercise of great care in cold weather concrete work. The Universal Portland Cement Co. has just issued the third edition of its bulletin on "Concreting in Cold Weather," which to the man engaged in this work, is invaluable. The engineers of construction on the various railroads would do well to obtain copies of this booklet for all superintendents, ass't. engineers, foremen and inspectors and supplement the same with such suggestions as they may see fit to make with regard to the special conditions to be met in each case.

Railway Engineering will be glad to devote space to articles or letters on the subject by men of experience, since we realize that there is much room for improvement in some of the methods used in cold weather concrete work.

Action of Reinforced Concrete Slabs Under Concentrated Loads

IN THE DESIGN of reinforced concrete slabs subject to concentrated loads, it is highly essential to have a quite definite knowledge of the width of the slab which will be effective in carrying the superimposed load in order that the design be neither too weak nor too strong and consequently uneconomical.

Very little of such information can be found in technical literature and therefore the results of tests made by Mr. A. T. Goldbeck, testing engineer of the Office of Public Roads, and given in a paper before the American Society for Testing Materials at the Atlantic City meeting, June 24-28, are interesting and instructive. The discussion of this paper by Mr. W. A. Slater, first assistant of the Engineering Experiment Station, University of Illinois, brings out the fact that the results obtained at this latter place concur with those obtained by Mr. Goldbeck.

The tests made by the Office of Public Roads were on slabs of three to six feet span, some with transverse steel also, and the results would indicate that the concentrated central load can be safely considered as being carried by a width of slab equivalent to not more than eight-tenths of the span. These values, however, can be only approximate, since in order to obtain correct values of effective width, the test slabs must be of such width as to have the deformation vanish at the sides; this was not the case in the test slabs.

Tests at the University of Illinois were made on a large number of beams having a span of four feet and widths varying from one-half the span up to twice the span, and a few others of different spans without transverse reinforcement. The tests brought out the fact that there is a sudden change in the distributing action between the points where the width is three-fourths of the span and equal to the span. At a width of twice the span, the ratio of total effective width to span becomes nearly constant and is equivalent to seven-tenths of the span.

Mr. Slater recommends, in view of the uncertainty of the tests, a safe value of the effective width to use would be $\frac{2}{3} x + e$, where x is the distance of the load from the support and e the width of the load. The longitudinal reinforcement should be limited to 1 per cent or less, in order that failure in a beam of relatively small depth will not occur by transverse tension in the concrete instead of by longitudinal stress in steel. The above formula should only be used when the width is greater than twice the span; for lesser values there is a proportionate reduction in effective width.

The variation in effective width due to variation in depth is very slight and the depth may be considered unimportant as influencing the effective width. In general, the tests show that the span length is about the only important factor governing the effective width. Tests have been made on beams having varying percentages of transverse reinforcement, but they have not shown conclusively that transverse reinforcement to resist transverse bending stress is economical. It seems, however, that in general there ought to be a small amount of transverse steel to provide for stresses and deformations due to temperature variations.

The Department of Railways and Canals of the Dominion of Canada has given a contract to the Hamilton Bridge Works Company, Ltd., Hamilton, Ont., for the material and the erection of a steel swing bridge over the new Welland canal at Merritton.

The Illinois Central has commenced grade separation work at Mattoon, Ill.

A new passenger station to be erected at Northport, N. Y., on the Long Island will cost about $20,000. The construction work will be carried out by the company's forces. This road will also begin work at once on a foot passageway to be constructed underneath the tracks in Atlantic avenue at the Railroad avenue crossing, Brooklyn, N. Y.

The Sumpter Valley has a steel bridge under construction. This road will relay 3 miles of steel next year.

CONCRETE WORK IN COLD WEATHER.

E. C. Bracken.

Until a few years ago it was the usual practice to suspend all concrete work as soon as freezing weather set in. Today there is a complete change of ideas on this matter, it being rightfully contended that concreting can be carried on in cold weather as well as in summer, by exercising proper precautions.

The hardening of concrete, its property of acquiring strength with age, is delayed by freezing, and if concrete is frozen before it acquires its final set, it will not attain its normal strength after thawing out and setting. Herein lies the danger of concreting in cold weather. Alternate freezing and thawing is even worse, since it causes the concrete to lose practically all its strength. If on the other hand the temperature of concrete at time of placing is such that it will remain above freezing until it has attained its final set, freezing cannot injure the concrete (except surface finish) other than to delay the hardening which takes place gradually after final set.

The problem, then, in winter concrete work is to heat the concrete mixture in some economical way and keep it at a temperature of from 45 to 50 deg. F. as long as possible after placing.

If the concrete is placed in a structure or part thereof where the concrete is in large masses and is in direct compression, as in foundations, piers and heavy walls, all that is required to have the concrete mixture at a temperature of about 60 to 75 deg. when placed, and keep the surface covered so as to retain the heat as long as possible. Under such conditions the concrete will have set and become quite hard before its temperature drops to that of the outer air and subsequent freezing will not injure the concrete.

In the case of bridges, buildings and thin reinforced concrete walls where the stresses in concrete are other than direct compression, further precautions are necessary. Such a structure must have acquired considerable strength before forms are removed, and the premature removal of forms is the danger to be guarded against. Consequently the concrete must have its final set and be well hardened before the temperature is allowed to drop below freezing. For, if concrete freezes before this, it is very likely to appear hard and well set when in reality it is frozen hard and will not be capable of carrying its own weight. If the forms are removed at this time, a collapse is the result.

The heating of sand, coarse aggregate and water is best accomplished by live steam furnished by an auxiliary boiler, or if the boilers of mixer and of hoisting engine are somewhat over-size, the necessary steam can be taken from them at a very small additional cost.

The water is best heated by placing a steam hose or pipe, equipped with a shut-off valve, into the water barrel or tank which supplies the mixer. If the mixer is running steadily, the supply of steam into the water tank can be regulated with ease so that the water will be very near the boiling point at all times. Some engineers object to using water as hot as 200 deg. F., but it is doubtful if there is any valid reason for this objection when one considers that by the time the mixer has revolved once, the water has been cooled sufficiently by contact with the sand and stone which, even if heated, are of much lower temperature, so that it cannot injure the cement. The temperature of the water can be easily varied somewhat so as to raise that of the sand and coarse aggregate, if they are not heated sufficiently.

Sand and gravel are readily heated by steam supplied through perforated steam pipes placed near the bottom of piles of material or by steam discharged into a wooden box punched full of holes to allow the steam to escape, the sand, gravel and stone being dumped thereon. Sometimes a steam pipe open only at the end is used to heat the materials, being stuck into the pile at various places as the material is heated. This method is more wasteful than the use of a perforated pipe and the heating of material is much more uneven, but in cases where the aggregates are frozen solid in the piles, they can be thawed out much quicker. Crushed stone requires much more steam to heat than does gravel on account of the greater proportion of voids.

In order to have materials hot at time of commencing work in the morning, steam should be supplied during the night to the piles of sand and gravel or stone. It is also imperative that in using this method of heating materials a considerable amount of sand and coarse aggregate should be kept on hand at all times to insure having them hot.

The materials (except cement) and water should be heated to such a degree that the temperature of the concrete when poured in place is from 60 to 75 deg. F. When the structure is of the second class mentioned, it is generally necessary to keep the concrete warm as long as possible by means of salamanders filled with burning coke placed underneath the forms, which should be closed up with tarpaulins to keep the heat in. In all cases the surface of the concrete should be covered so as to retain heat and protect concrete. In some cases, when it is necessary to use the structure as soon as possible after concreting, it is best to keep heat under the forms continuously, in which case the forms can be removed almost as soon as in summer.

In all winter concrete work it is well to remember that a dollar's worth of heat applied at time of mixing is better than several dollars spent in trying to heat cold concrete after it is in place.

CURRENT PRICES—CONCRETE MATERIALS.

Portland Cement—Prices given include cost of sacks, for which in general 40 cents per barrel (4 sacks) is refunded on return in good condition. Prices per barrel at various points are as follows: New York, $1.60; Boston, $1.71; Pittsburgh, $1.60; Cleveland, $1.70; Detroit, $1.69; Toledo, $1.69; Indianapolis, $1.73; Peoria, $1.69; Chicago, $1.60; Milwaukee, $1.69; Madison, Wis., $1.77; Minneapolis and St. Paul, $1.80; Davenport, $1.70; Cedar Rapids, Ia., $1.80; Portland, Ore., $2.40; Spokane, ——; Tacoma, $2.40; Seattle, $1.85. Above prices are f. o. b. cars at points named.

Crushed Stone—1½-inch stone, 85 to 95 cents per cubic yard, in full cargo lots at docks. Chicago, $1.15 per cu. yd.; Portland, Ore., $1.10 per cu. yd.; Seattle, $1.45 per cu. yd.; Spokane, —— per cu. yd.; Tacoma, $1.45 per cu. yd., in carload lots f. o. b. cars.

Gravel—New York, 85c to 95c per cu. yd., in full cargo lots at docks; Chicago, $1.15 per cu. yd.; Portland, Ore., $1.00 per cu. yd.; Seattle, 75c per cu. yd.; Spokane, —— per cu. yd.; Tacoma, 85c per cu. yd. Above prices are f. o. b. cars in carload lots.

Sand—New York, 50c per cu. yd., full cargo lots at docks; Chicago, $1.15 per cu. yd.; Seattle, 75c per cu. yd.; Portland, Ore., $1.00 per cu. yd.; Spokane, —— per cu. yd.; Tacoma, 85c per cu. yd. Above prices are f. o. b. cars in carload lots.

Reinforcing Bars—Pittsburgh base quotations on mill shipments, f. o. b., are 1.45c per lb.; on large orders, quotations of 1.40c can be obtained, with the prevailing extras for bars under ¾ inch or base. The following are quotations on base bars for mill shipments from other points: Chicago, 1.58c to 1.63c f. o. b.; Portland, Ore., 2.30c f. o. b.; Seattle and Tacoma, 2.10c f. o. b. Shipments from stock are being made at the following prices: Pittsburgh, 1.90c f. o. b.; New York, 2.20c f. o. b.; Chicago, 2.00c to 2.05c f. o. b.; Portland, Ore., 2.60c f. o. b.; Spokane, ——c f. o. b.; Seattle, 2.40c f. o. b.; Tacoma, 2.40c f. o. b. The demand is not very active but the tendency is toward a maintenance of the present prices.

Metal Clips for Supporting Bars—$7.25 to $8.00 per 1,000, depending on size.

For the majority of the prices given above we are indebted to the Universal Portland Cement Co., Sandusky Cement Co., Concrete Steel Co., Chicago and New York, and F. T. Crowe & Co., of Seattle, Portland, Spokane and Tacoma, Wash.

APPLICATION OF CONCRETE IN THE ABOLISHMENT OF GRADE CROSSINGS, PHILADELPHIA, PA., 1912.*

By Jas. W. Phillips, Assistant Engineer, Bureau of Surveys.

The latest and most important track elevation work in Philadelphia is the abolishment of all grade crossings along the line of the Philadelphia, Germantown & Norristown Railroad between Green street and Wayne Junction, a distance of 3.25 miles and through a densely built-up part of the city. This work, which is about completed, abolished twenty-eight grade crossings and opened up two additional streets. In this work the railroad tracks were elevated and all streets pass underneath.

The P. G. & N. R. R. was one of the first to be built to the city, if not the first railroad built in this country, and was built about 1832-33, as trains were operated on the road between its terminus at Ninth and Green streets and Germantown in 1834.

Connecting at Green street, the tracks are carried on an earth fill and retaining walls to the south side of Brown street, with bridges over Fairmount avenue; from the south side of Brown street to the north side of Jefferson street they are carried on a four-track steel-trough floor viaduct; from the north side of Jefferson street to Broad street by earth-fill and retaining walls with bridges over streets, coming to the grade of the present tracks at a point about the south line of Broad street, thence commencing to rise again at Seventeenth and Indiana streets, whence they are carried on earth-fill between retaining walls until they meet the grade of the present track just north of Hunting Park avenue. All bridges are of the plate-girder type, except at Berks street and Norris street, where there was sufficient headroom to permit the construction of concrete arches under the main tracks.

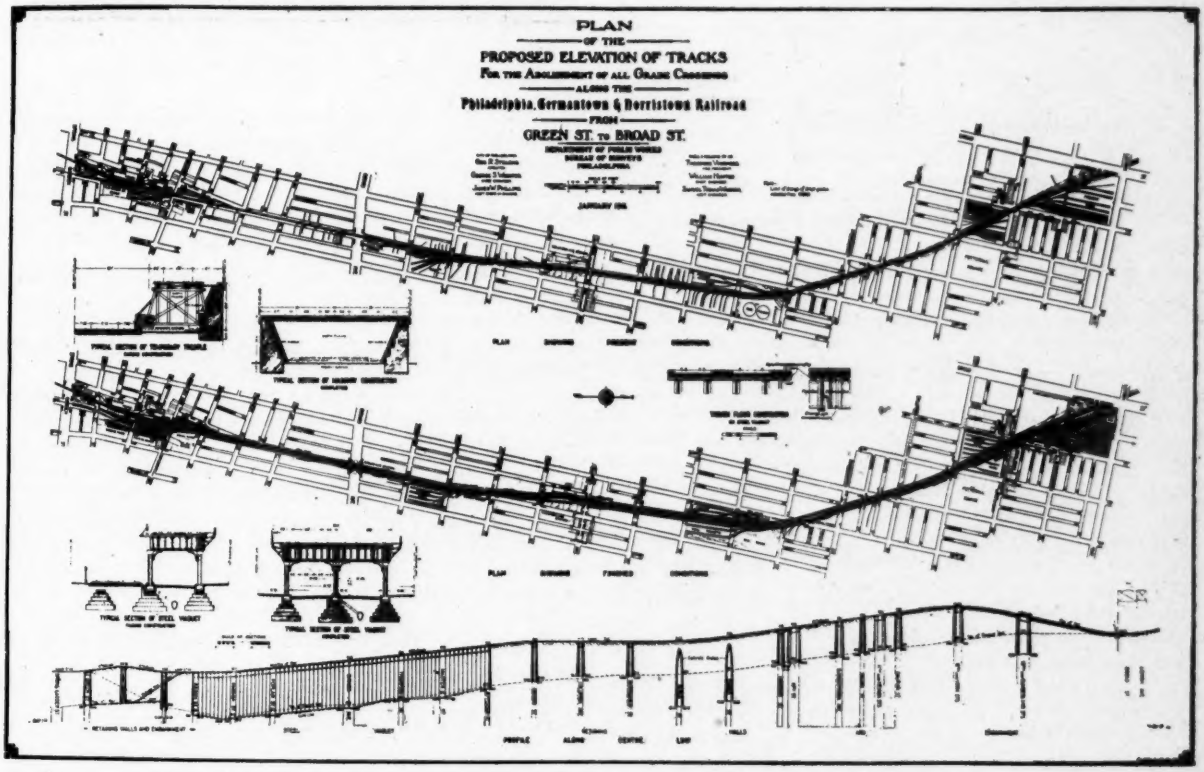


Fig 1. Plan and Elevation, P. G. & N. R. R. Grade Crossing Elimination, Philadelphia.

Concrete Arches and Retaining Walls, Berks and Norris Streets. (Figure 2.)

The concrete arches have a span of 50 ft. with a rise of 10 ft. 9⅝ in. for the arch over Berks street, and a rise of 11 ft. 1⅛ in. for the Norris street arch, and a crown thickness of 3 ft.

In order to maintain railroad traffic it was necessary to construct each arch in two sections. After the completion of the first section traffic was transferred to the new elevation and the remainder of the arch completed. The points between the two sections were made in the manner of a tongue and groove with 1¼ in. rods about 8 ft. long placed in the first half of the arch ring, having a projection of 4 ft. in order to engage the second section when constructed. No other reinforcement was used.

The Berks street arch was waterproofed by using five layers of Genasco postive seal felt laid in Genasco compound and protected by a layer of 1:3 cement mortar 1 in. thick. The Norris street arch was waterproofed by using 1½ in. of asphalt mastic, made by mixing 1 part of Barber Asphalt Co.'s compound, No. 483, with 4 parts of sand and screenings. This mixture was laid in two layers of ¾ in. each and each layer breaking points. The waterproofing on both of these arches has been very satisfactory.

The cost was as follows:

Berks street	$0.23 per sq. ft.
Norris street	.30 per sq. ft.

The cost of different grades of concrete was:

1-2-4	concrete, arch ring, including centers	$7.50 per cu. yd.
1-3-6	" copings	6.75 per sq. yd.
1-3-6	" abutments	6.00 per cu. yd.

Freight Yards.

Three freight yards were reconstructed, one at Eighth and Master streets, one at Tenth and Berks streets, and one at York and Cumberland streets. These yards were raised from about street grade to an elevation a little below the new elevation of the main tracks, and driveways leading from the street level

*Abstract of paper presented at the National Association of Cement Users' Convention at Pittsburgh, December, 1912.

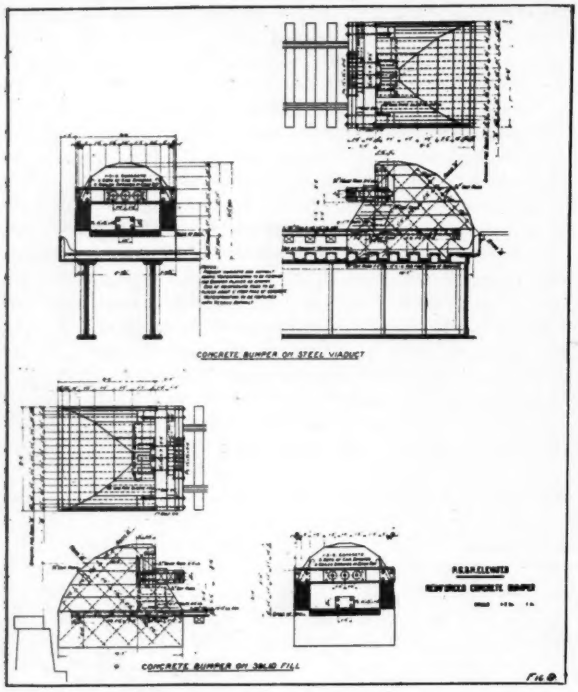


Fig. 6. Plan and Sections, Concrete Bumping Post.

were constructed, having a 3 per cent grade, ramp and retaining walls in each case being constructed of concrete.

Figure 3 shows a ramp wall, constructed along the west side of the main tracks and on the east side of the Berks street freight yard. The same type of wall was constructed as a ramp wall along the west side of this yard and along the driveway approach to the yard. Referring to the wall in Fig. 3, the only reinforcement used was bars in the bottom and sides of that portion between piers. Expansion joints were provided over every second pier by means of ⅛ in. asbestos boards set in the concrete. All walls were backed with a dry stone packing, and along the bottom offset 6 in. vitrified clay pipe was laid on about a 1 per cent grade for drainage. These drains were carried out through the abutments and walls, as the case might be, and then connected to the sewers in the streets.

Figure 4 shows the face finish of an abutment at Norris street. The same finish was used on all concrete abutments and retaining walls facing streets. The only case where this face finish was not used was on the ramp wall along the driveway leading to the Tenth and Berks streets freight yard, where the face was peen hammered.

In all concrete walls and abutments expansion joints were provided about every 50 ft. by using ⅛ in. asbestos boards.

Figure 5 shows a concrete bumping post, as constructed in

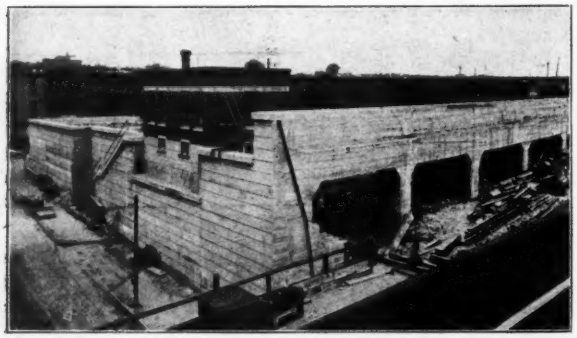


Fig. 3. Ramp Wall, Northeast Corner 10th and Berks Streets.

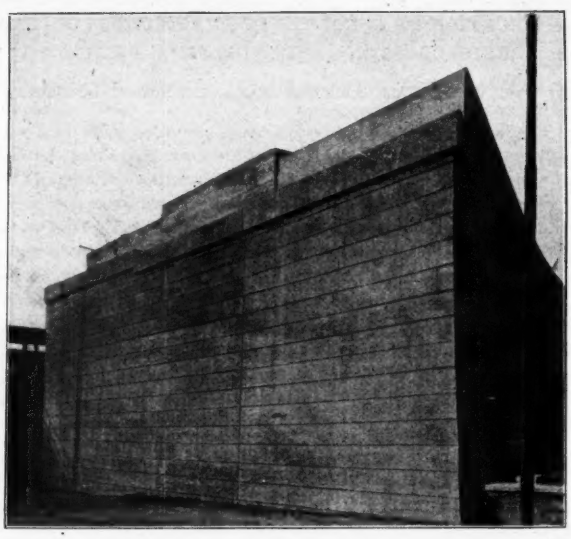


Fig. 4. North Abutment, Norris Street.

the York and Cumberland streets freight yard, at the terminus of a track with a 3 per cent grade, it having been found that an Ellis bumper would not stand. Figure 6 shows detail plans for reinforced concrete bumpers for use on steel viaducts and on solid fill.

Waterproofing.

In the waterproofing of the steel bridges and viaduct two methods were used; the first, that of filling the trough floors with concrete and flushing it up against the webs of the girders in the case of half through or through bridges, and then waterproofing the whole surface with a 1½ in. layer of asphalt, laid in two ¾ in. layers with tapped joints, was used on all bridges between Green street and Berks street, the bridges in the Tioga section and the viaduct. The second method was used on bridges between Berks street and Broad street; the trough-floor bridges were waterproofed with 1½ in. of asphalt laid in ¾ in. layers by covering the bottom, sides and tops of the troughs to their centers. Drainage was provided by inserting nipples in the bottoms of the troughs, which carried the seepage to a suspended trough below, connected to a downspout on the curb columns.

Unit Cost of Waterproofing.

Hydrex felt (five layers with Hydrex compound)	$ 0.165 per sq. ft.
Hard brick laid in Hydrex compound	.08 per sq. ft.

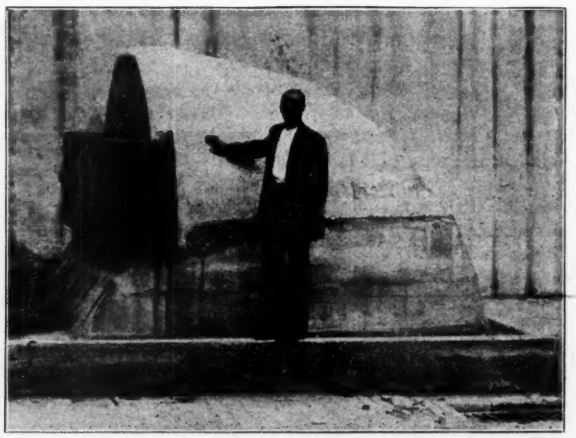


Fig. 3. Concrete Bumping Post.

Asphalt mastic	34.65	per cu. yd.
" " on viaduct	.24	per sq. ft.

Unit Prices of Material.

This table gives the average unit prices of some of the important materials used in the work, except waterproofing:

1st class masonry, concrete backing	$ 9.50	per cu. yd.
1st " " 3rd class "	8.14	" " "
2nd " " " " "	7.42	" " "
3rd " " above neat lines	5.71	" " "
3rd " " in foundations	5.43	" " "
1st " arch masonry	11.25	" " "
1-2-4 concrete arch masonry	7.95	" " "
1-3-6 " copings	7.54	" " "
1-3-6 " masonry (1½ in. stone)	6.45	" " "
1-3-6 " " (¾ in. stone)	6.45	" " "
1-2-4 " bridge seats (¾ in. stone)	7.62	" " "
1-2-4 " pedestal blocks (¾ in. stone)	7.62	" " "
1-3-6 " masonry, above neat lines, street face	6.74	" " "
1-3-6 " masonry, above neat lines	6.32	" " "
1-3-6 " masonry in foundations	5.82	" " "
Dry Stone back of walls and abutments	2.65	" " "

GENERAL DATA.

Street Railroad Crossings abolished	28
Number of steel bridges constructed	20
Number of concrete arches constructed	2
Structural Steel	27,180 tons
Third Class Masonry	67,500 cu. yds.
Concrete Masonry, all classes	151,800 cu. yds.
Cement	231,800 barrels
Earth embankment	431,000 cu. yds.
Street excavation	140,000 cu. yds.
Street paving, all kinds	134,312 cu. yds.
Sewers constructed	17,840 lin. ft.
Miles of single permanent track	30.1
Length of viaduct	3,365 lin. ft.
Total steel in viaduct	15,005 tons
Averaged weight of 4 track viaduct, per lin. ft.	7,617 lbs.
Averaged weight per sq. ft. of viaduct	152 lbs,
Area of floor of viaduct	197,300 sq. ft.

DISTRICTS FOR VALUATION WORK.

The Interstate Commerce Commission has made a tentative division of railway territory in the five valuation districts, each embracing about 50,000 miles of railroad. The following tabulation shows the territory included in each of these districts: No. 1—Eastern: Headquarters, Washington, D. C.; Connecticut, Delaware, District of Columbia, Maine, Massachusetts, New Hampshire, New Jersey, West Virginia, New York, North Carolina, Pennsylvania, Rhode Island, Virginia, Vermont. No. 2—Southern: Headquarters, Chattanooga, Tenn.; Alabama, Florida, Georgia, Indiana, Kentucky, Mississippi, Ohio, Panama, Porto Rico, South Carolina, Tennessee. No. 3—Central: Headquarters, Chicago, Ill.; Illinois, Iowa, Louisiana, Michigan, Wisconsin. No. 4—Western: Headquarters, Kansas City, Mo.; Colorado, Kansas, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, Texas. No. 5—Pacific: Headquarters, San Francisco, Cal.; Alaska, Arizona, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming.

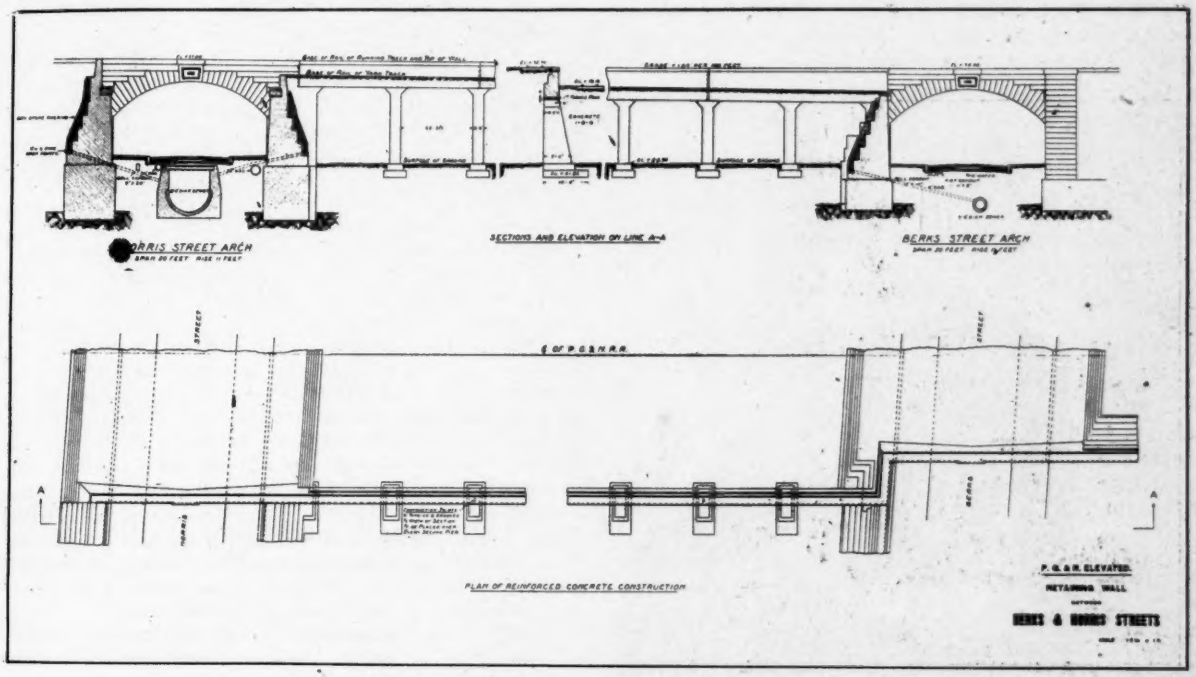

NORRIS STREET ARCH
SECTIONS AND ELEVATION ON LINE A-A
BERKS STREET ARCH
PLAN OF REINFORCED CONCRETE CONSTRUCTION
P. R. & N. ELEVATED
RETAINING WALL
BERKS & NORRIS STREETS

Fig 2. Retaining Walls, Berks to Norris Streets.

In keeping with the policy of widening the Chicago river, a portion of the Jackson boulevard by-pass channel (built at the time of the construction of the drainage canal) has just been removed. This by-pass consisted of concrete and dimension stone sidewalls, supporting 4 ft. plate girders of 50 ft. span spaced 10 and 15 ft. apart, with concrete jack arches between, upon which was placed an earth fill and sidetracks of the Pennsylvania R. R. The jack arches were 12 to 15 inches thick at the crown which is at a lower level than tops of girders, and were increased in thickness at the girders so as to entirely encase them, thus forming ridges over the girders.

After removing the tracks and fill, a floating drop-hammer pile driver was moored at the entrance to the by-pass, and the pile driver itself transferred to rollers on timbers resting on the roof of the structure. The breaking up of the concrete, which was not reinforced, was started at the crown of arches, which were broken through with a few blows. At the girders the task was more difficult and the top flanges of some of them were bent at points where the concrete was exceptionally hard to remove. The original paint on the girders was found to be in a good state of preservation. The girders were removed by derricks, the sidewalls removed, and the broken concrete dredged from the channel.

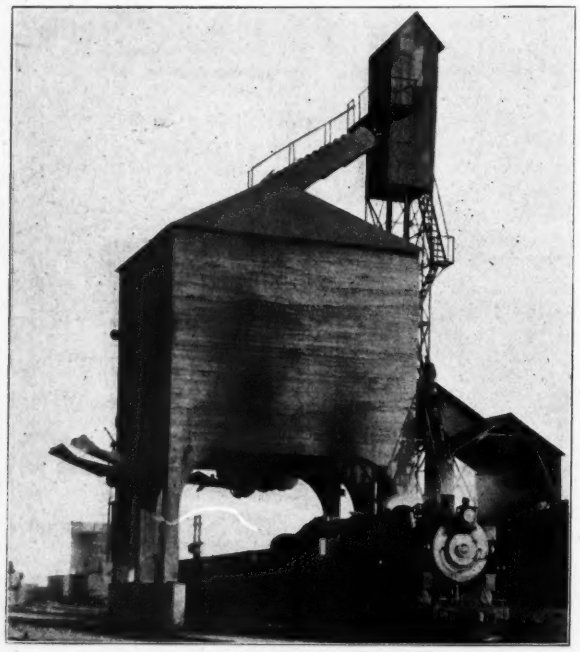
REINFORCED CONCRETE COALING STATION—VANDALIA R. R. AT EAST ST. LOUIS, ILL.

By A. M. Wolf, C. E.

Introduction.

Concrete coaling stations are becoming standard structures on many railroads, although a few years ago all large coaling stations were of timber construction, since no other economical method of construction was then available. The extensive use of reinforced concrete in all lines of construction work has, however, made possible the fireproof coaling station at about 30 per cent to 40 per cent more than that of a timber pocket with the same type of operating machinery.

The main trouble to be contended with in coaling stations of large capacity is spontaneous combustion of the coal, with consequent loss of coal, valuable machinery and the structure itself if it is not of fireproof construction. A great amount of inconvenience and expense has been incurred by the railroads by the use of timber coaling stations and it is therefore



Reinforced Concrete Coaling Station, Vandalia R. R.

only natural for them to readily accept the reinforced concrete coaling station as the most economical and practical design.

The prime requisites of a coaling station are fireproofness, strength, permanence and low maintenance cost. A concrete pocket possesses all these advantages and as previously stated at a first cost of little more than for wood or steel, and can therefore be called the ideal type of construction.

Among the first concrete coaling stations to be erected were those of the Holmen balanced bucket type as built by the Roberts & Schaefer Co., engineers and contractors, Chicago, Ill. The one described here represents one of the latest designs having recently been erected by this company for the Vandalia R. R. at East St. Louis, Ill.

Design.

This station is automatically operated by electrical machinery, has a capacity of 500 tons and is designed to coal locomotives on three tracks. The bins are carried on six reinforced concrete columns, three on each side, resting on a continuous concrete footing course extending about 4 ft. above grade as a protection for the columns. The bins are of reinforced concrete construction throughout, the sidewalls being heavily reinforced in such a manner as to best resist the lateral pressure exerted by the coal. The sloping bin bottoms are also of reinforced concrete. All concrete used in this structure was of a 1:2:4 mixture. High carbon corrugated square bars meeting the manufacturers' standard specifications were used for reinforcement. The roof of the station and also the bucket tower is of structural steel covered with rust resisting American ingot iron.

Operation.

The coal is discharged from the coal cars into a concrete coal hopper at one side of the station from whence it is automatically fed through a Roberts & Schaefer Co. automatic measuring feeder into the Holmen type bucket and hoisted up over the pocket into which the coal discharges. The measuring device is arranged to deliver the exact amount of coal, viz., 2½ tons to the bucket, and is actuated by the ascent and descent of the elevating bucket.

The counterbalanced bucket has a 6 in. diameter steel roller on the bucket apron, which travels on a continuous steel guide from the bucket pit to the discharge point over the coal pocket, which positively assures the closing of the bucket at all times except when discharging. All closing springs, latches, dumping curves, trippers and other light mechanism, so likely to get out of order, are eliminated by this type of bucket. The coal is permitted to slide out when the bucket is discharging on a straight line with the chute to the bin, thus making additional height of tower required to turn over a skip bucket unnecessary and at the same time doing away with trouble from buckets getting stuck on curves. The bucket is operated by a Cutler-Hammer automatic controller and time switch with solenoid brake, which guarantees a continuous operation of the hoisting bucket without the attention of the man in charge, while coal is being elevated. The automatic feature of this station is not accomplished in the hoist, but by the electric equipment at the discharge point, thereby eliminating the trouble which would arise from the usual stretch in the hoisting cable.

The coaling plant at East St. Louis is electrically operated, but without the automatic feature. These plants are now being installed by the above company with an automatic controller and time switch, which permits a continuous operation of the hoisting bucket in the ascent and reverse without the attention of a man at the controller. The operator's time can, therefore, be used in handling cars over the track hopper.

Coal is discharged from the pocket through positive rack and pinion undercut gates, with heavy hooded apron fixtures. The undercut gate is acknowledged as the best practice and is operated by manual power with perfect ease, no counterweights being employed to close the gate, thus preventing flooding of the locomotive tender with coal. With these gates a large tender can be coaled in thirty seconds.

This station has been in operation for some time and has given perfect satisfaction. We are indebted to the Roberts and Schaefer Co. for photograph and data used in this article.

MARTIN'S CREEK VIADUCT—D. L. & W. R. R.

The Martins Creek Viaduct, on the new Summit Cutoff of the Delaware, Lackawana & Western R. R., at Kingleys, Pa., about 32 miles west of Scranton, is now under construction. This structure is a three track concrete arch viaduct 47 ft. wide and about 1,600 ft. long, composed of two 100 ft. semicircular arches, seven 150 ft. three centered arches with a rise of 59 ft., and two 50 ft. approach arches covered with earth fill acting as hollow abutments. The concrete deck carrying track and ballast will be composed of 12 ft. 6 in. transverse spandrel arches. The height of bridge from creek to top of rail will be 150 ft. The deepest foundations will extend 25 ft. below creek level to rock. It is estimated that 77,500 cu. yds. of concrete and 800 tons of reinforcing steel will be used in this bridge.

New Books

BUILDING CONSTRUCTION—VOL. II OF THE ARCHITECTS' LIBRARY. By. J. H. Markham, A. R. I. B. A. and others. Edited by F. M. Simpson. Cloth, 6x9 in. 360 pages; 142 illustrations. Pub. by Longmans, Green and Co., New York and London. Price $4.00 net.

An English book, written expressly for the English architect, and therefore not exactly suitable for extensive use by the American Architect on account of the wide diversity of construction methods used here and in England.

The first part of the book is a short treatise on reinforced concrete based on the fundamentals embodied in the reports of the committee on reinforced concrete of the Royal Institute of British Architects. The nomenclature is of course, British and somewhat different from the standard used in this country. Some of the typical details of beam and girder reinforcement shown may be satisfactory in England but applied to American conditions they would be impossible. The subject of columns is treated in an interesting manner.

Following the treatment of reinforced concrete, roof coverings and glazing are discussed. The subject of joinery is next taken up in a commendable manner, followed by an exposition of plastering and painting and decorating.

The Book is British in every respect and although not exactly suited to American conditions, contains much of inferest to the architect by way of comparison with methods used here and abroad.

THE DESIGN AND CONSTRUCTION OF METALLIC BRIDGES. By Wm. H. Burr and Myron S. Falk. 3rd edition, revised. Cloth 6x9 in. 512 pages, many text figures, 4 folding plates. Published by John Wiley & Sons, New York. Price $5.00.

This is a comprehensive book covering all types of trusses used in or forming a basis for American bridge practice, employing the most advanced methods of stress computations for such structures. A notable feature of the work is the use of the methods of influence lines and deflections in the treatment of swing-bridges in addition to the usual procedure with the theorem of three moments. Graphic methods of analysis are little used in this book, a complete treatment of this theory being set forth in "The Graphic Method by Influence Lines for Bridge and Roof Computations," by the same authors. These two books are companion volumes and together comprise a complete treatment of metallic bridges, except suspension bridges and arched ribs, it being the intention to treat these structures in another volume. All typographical or other corrections necessary to make the text as perfect as possible have been made in this edition.

A short historical sketch of bridge building comprises the first chapter. The sketch as a whole is interesting but the portion on modern structures has not been brought up-to-date, the latest structures mentioned are those being built in 1905. The same criticism holds good for the chapter on general types of trusses, loads and specifications, especially with respect to the latter. This portion could have been made much more authoritative by including the recommendations of the A. R. E. A. regarding steel structures, either all, or in part. Chapter 3 is a discussion of moments and shears in general and special cases and also gives the complete detail design of a 90 ft. deck plate girder span for Coopers E-50 live load. The next two chapters treat of stresses in parallel and horizontal chord trusses, and non-continuous trusses with chords not parallel. Chapter 6 is a brief statement on influence lines which are used in the discussion of swing-bridges which follows. This latter subject is one of the most valuable in the book and as a general treatment of the stresses in such structures and the power required to operate them, it is to be commended. The deflection of framed structures and an outline of the theorem of least work make up chapter 8. The stresses caused in various structures by wind are next treated. The book ends with a comparatively short but well arranged chapter on the details of construction.

The typography and general arrangement of the book are excellent. The character and standard of the book in general is high and it therefore merits extensive use both as a text and a reference work.

CIVIL ENGINEERS' POCKETBOOK. *By Albert I. Frye.* M. A. S. C. E. 4½x7 in. morocco; 1,670 pages, 600 tables, 1,200 cuts. Published by D. Van Nostrand Company, New York City. Price, $5.00 net.

The writing of a treatise on Civil Engineering is a task of such great magnitude that one wonders how any one man can write and edit such a work in the period of a few years. This Mr. Frye has done in a commendable manner, especially so in the matter of tables, in which the book is very profuse. As is to be expected in a large work of this kind, there are certain portions of the book which are far below the standard set by the others. It is an undeniable fact that no man can be highly proficient in all branches of a field of such wide scope as civil engineering in this age of specialization, and this fact holds good in the case in question. This at once suggests that the best method of obtaining a work of a uniform high standard is by the editing of various portions of the book by engineers specializing in various lines, the whole to be supervised and edited in general by a man of unusually broad experience. However, leaving the facts as they are, there is no denying that Mr. Frye has accomplished a great work and has added a valuable contribution to the literature relating to civil engineering. It is safe to say that the later editions of this work, which will be necessary to keep the book up-to-date, will remedy many or all of the weaknesses of this first edition. The tables incorporated in the book are the strong feature and deserve special mention, many of them having never before appeared in print, at least in their present form; the value of some, however, is problematic.

The book is made up of seventy sections treating the main subjects of civil engineering in an economic manner, with special attention to methods and cost of work. Excerpts from and references to, the most important cost and other data in the leading technical publications, are given at the end of each section. The fact that these references and excerpts are only carried up to the latter part of 1910 stamps this feature as being not quite up-to-date. If such material is to take up valuable space in a book of this kind it should at least cover the field up to within a short time of publication. The same criticism holds good in several other instances, e. g.: Tables of Azimuths of Polaris are given up to and including 1912 only; abstracts from building codes of various cities are several years behind; the list of typical modern arches does not include any structures built later than 1907, notwithstanding the fact that the largest arches have been built within the last few years. In a few cases exactly the same information derived from two different sources with a different nomenclature has been incorporated in the book. This shows lack of correlation and means the loss of valuable space which would allow of a more complete discussion if properly utilized. The sections on reinforced concrete are examples of this fault, and for such an important subject are woefully weak. The chapters on buildings and foundations fall far short of the author's aim to give the young engineer the principles of design or definite data on design. The portion on foundations is a back number insofar as foundations proper are concerned, an example of the design of an I-beam grillage only, being given even though reinforced concrete footings are now used to a much greater extent. Nothing is given as to the proper proportioning of interior and exterior column footings in buildings in order to obtain balanced conditions. Such things as these are what the young engineer seeks for, and a book of this sort which does not include them falls short of its purpose.

Chapters on mathematics, algebra, trigonometry, geometry and

mensuration are the most complete ever published in a book of this sort. The sections dealing with bridge and general structural steel designing and detailing are very complete and contain many valuable tables for the structural engineer, some of them alone being worth the cost of the book. The sections on surveying and railroads contain much data and many tables of interest and value to the railroad engineer. Hydraulic, water supply and waterworks form important chapters replete with many new and handy tables for the hydraulic engineer. An extensive glossary and the index covering over 100 pages form a valuable asset to the work.

On account of the great number of tables and the size of some of them, a very small type has in general been used, which in some cases makes rapid use of the tables difficult. The line figures are excellent, but some are reduced altogether too much. The typography and general arrangement of the book are excellent and deserve special comment. We fully realize that perfection cannot always be obtained in the first attempt and some of the shortcomings of this first edition can be overlooked on account of the general high standard set by the majority of sections of the book.

A TREATISE ON WOODEN TRESTLE BRIDGES AND THEIR CONCRETE SUBSTITUTES. By Wolcott C. Foster. Fourth Edition. Revised and enlarged. Cloth, 9x12 in., 440 pages, 76 plates. Published by John Wiley & Sons, New York. $5.00 net.

This volume which for many years has been considered the standard treatise on the subject, has been brought up to date in this fourth edition and some material on concrete trestles as substitutes for those of wood added. Wooden trestles, though little used on main lines except for temporary work, are still being used to a very large extent on branch or feeder lines and on electric roads which proves that they are not losing their importance, and therefore the revision of this work is justifiable.

In this edition much has been rewritten and new matter added to each chapter. Much has been drawn from the proceedings of railway clubs and engineering associations, having permanent committees on wooden bridges and trestles, in the shape of standards and rules of practice which add materially to its value. Two new chapters, one on timber preservation and one on concrete trestles have been added to Part I which now contains seventeen chapters with a total of 236 pages, dealing with the theory and details of design and construction of trestles.

Part II consists of 156 pages of Standard Trestle Plans, including the most modern designs for heavy traffic. Part III is an extensive bibliography of the subject and of related matters of interest in construction and maintenance of trestles, and should prove invaluable to the bridge engineer.

As far as wooden trestles are concerned the book is of the highest order, but the portions on concrete trestles are far below this standard and not a strong feature as they deserve to be. The chapter on concrete trestles is in fact nothing more than an abstracted description of those built by one railway, no theory of design, details of construction or discussion of their adaptability to conditions being given. In Part II a few standard details and descriptions of concrete trestles taken from various publications are given. In view of the treatment accorded concrete trestles it appears that this section did not receive the same painstaking care and thoroughness that characterizes the main portion of the work, this, however, should not detract from the value of the work as a treatise on wooden trestles, which should be in every bridge engineer's library.

The typography and general arrangement of the book are excellent, the book is, however, rather bulky and not as attractive as the standard 6x9 in. books now being used almost entirely.

PUBLIC UTILITIES; THEIR COST NEW AND DEPRECIATION. By Hammond V. Hayes, Consulting Engineer. Board, 6x9 in., 260 pages. Published by D. Van Nostrand Co., 25 Park Place, New York City. Price, $2.00.

The present status of the valuation of the railway makes Mr. Hayes' book of timely interest, especially in view of the fact that it is comprehensive and uses much material gleaned from judgments in railway cases.

The book is written from the standpoint of the engineer, and is not offered as an authoritative discussion of the legal questions involved.

The preface states that it is the function of the engineer to make appraisals, but it lies with the court or commission to ascertain fair present value. In developing this subject in the text, it is stated that present value should be determined from a study of the following figures: (1) Original cost of the entire property useful to the public at time of appraisal; (2) Replacement cost; (3) Depreciation; (4) Amount and market value of stocks and bonds; (5) Commercial or capitalized value of the business of the undertaking, based on present and possible future earnings and operating expenses; (6) Reasonable worth of service to consumers.

The rest of the book is a development based on the above mentioned six and closely related topics.

Value as a "going concern" (No. 5) varies widely in the cases of different companies working under similar conditions. For instance, we find two properties working under very similar conditions, but with wide differences in net earnings. Where the conditions are similar, the only difference in the conduct of the properties is in the management. The value as a "going concern" is vitally dependent on the ability of the officers. An efficiently managed plant is of much greater value than an inefficiently managed plant, and providing gross earnings are the same, the efficient plant will of course show much greater earnings, even though the original and replacement costs of the two plants are the same. Going value would therefore seem to be one of the very important values to be considered. If the value of a plant is not to be increased, in the eyes of the law, by increased efficiency, what incentive is there to decrease the cost of production and thereby the cost of service to the consumer?

This book differentiates very carefully between the different valuations, and thus helps greatly to clear up many of the points which are likely to be confused in the consideration of the whole subject.

Interest on funds, in the replacement method, is held, by the author, to be a proper charge by all authorities, and in this connection a case is even cited where a judgment states that the interest is to be "the customary rate of interest prevailing upon loans of equal security or hazard."

With regard to charge for engineering the following evident truth is stated: "Most of the work of engineering force is essential to the greatest economy and efficiency in the construction and operation of the plant."

Another point called attention to is that there are two "fair present values" for property; one used by the state to regulate rates; one used by the courts to determine the fairness of the rates allowed. In the latter case, it is stated that "the cost new must be the replacement cost; and the actual present value must be the replacement cost of the property less depreciation."

The book is diveded into numbered paragraphs, each with a topic or sub-head which appears in the table of contents. This increases the ease of using the book and of rapidly locating any particular topic. This is a commendable feature.

This book is treated more nearly from a railway property standpoint than any heretofore published.

The Maryland & Pennsylvania will build a new station at Baltimore, Md., at an expenditure of $60,000.

The Missouri Pacific is planning, it is said, to enlarge its yards at Omaha, Neb., and will begin elevation of its belt line tracks within the next year.

The Montour has given a contract to the McClintic-Marshall Construction Co. for 1,000 tons of steel for a viaduct at McDonald, Pa.

The Signal Department

RAILWAY SIGNAL ASSOCIATION CONVENTION AT NASHVILLE.

The eighteenth annual convention of the Railway Signal Association was held at Nashville, Tenn., in the Hotel Hermitage, on October 14th, 15th and 16th. The attendance was exceptionally good, the meeting being one of the largest ever held by the association.

President B. H. Mann, signal engineer of the Missouri Pacific, in his opening address credited the committees of the association with an unusually large amount of work turned out during the past year.

COMMITTEE NO. 1 SIGNALLING PRACTICE.

Mr. Thos. S. Stevens, Chairman.

This committee was instructed to investigate and report the following subjects:

(a) Report on the effect of treated and metal ties on track circuits.

(b) Economics of labor in signal maintenance.

(c) Formulate and submit requisites for switch indicators, including method of conveying information as to condition of the block to the conductor and engineman.

(d) Investigate and report on automatic train control.

In connection with subject (a) the following report was submitted as information:

REPORT ON THE EFFECT OF TREATED AND METAL TIES ON TRACK CIRCUITS.

The effect of metal ties is self-evident. Each rail must be completely insulated from its ties to prevent a short circuit (similar to the action of the wheels and axles of a train). Defective insulation at any point will cause leakage and defective insulation at both ends of only one tie will throw the track circuit out of service.

The effect of creosoted ties is not serious and, with alternating current track circuits, is negligible. The effect of zinc-treated ties is more problematical.

The response to the circular sent to all members on June 1 was most gratifying. One hundred and twenty-six replies were received, representing 92 railroads—many of them trunk lines. Sixty-nine of these use no zinc-treated ties; four use them to such a limited extent as to render a report valueless, including two which are making the first installation this year; seven use them extensively, but not where track circuits are in service; twelve only use them with track circuits, showing that, while the subject is decidedly important to these roads, it does not at the present time, in view of this small percentage, appear to be of great general interest; although, if it could be shown that this treatment did not affect track circuits seriously, its use might be extended.

A summary of reports received shows:

(1) That track circuits a mile in length are rendered inoperative by the extensive use of zinc-treated ties.

(2) That track circuits 2,000 feet in length may be operated successfully, even with 50 per cent. or more of ties so treated.

(3) That 10 per cent. to 15 per cent. renewals a year will not materially affect such length circuits.

(4) That, where renewals are made of 15 to 20 adjacent ties, the leakage is much greater than where they are made singly at uniform distances, i. e., with 15 per cent. renewals (every sixth or seventh tie).

(5) That, while the surface salts are present, more leakage occurs during wet weather than with untreated ties, as these wet salts form a better conductor than ordinary wet wood.

(6) That, in dry, hot weather, the salts are drawn to the surface and constitute a more or less perfect conductor.

(7) That, after a period varying from three months to a year, these salts disappear and subsequently no interference is noticeable.

Subjects (b) and (d).

In connection with subjects (b) and (d), economics of labor in signal maintenance and automatic train control, considerable discussion had been given the questions at the committee meetings but no definite conclusions had been reached and the committee requested that the subjects be continued next year.

Switch Indicators.

In connection with subject (c), the following was submitted for discussion to bring out ideas for the information of the committee:

1. Location.

Indicators should be installed at:

(a) Trailing-point main-track switch of passing siding or track on which trains may clear main track.

(b) Switches of trailing-point crossover between main tracks—the indicator at the switch indicating the approach of train on the other track.

(c) Switch at side-track end of trailing-point cross-over between side track and main track.

Indicators are unnecessary at:

(d) Facing-point main track switch of passing siding or track on which trains may clear main track.

(e) Switches of facing-point crossover between side track and main track.

(f) Switches of facing-point crossover between main tracks.

(g) Switch of track on which trains cannot clear main track.

2. Control.

The switch indicator should be used to indicate only the approach of trains.

3. Extent of control.

The indicator should indicate stop when train reaches track circuit not less than.....feet in the rear of caution signal protecting switch under the normal-clear automatic block signal system or when train reaches clearing circuit for signal protecting the switch under the normal-danger automatic block system, and should remain at stop until train passes the signal protecting the switch or a point opposite the clearance point of the switch if it is located.....feet beyond signal protecting it. The above release point is advisable to facilitate train movements; if it is desired that train shall remain clear of the main track until the train passes the signal in advance of the switch, the indicator control may be so extended.

COMMITTEE NO. 2, MECHANICAL INTERLOCKING.

C. J. Kelloway, Chairman.

This committee was instructed:

(a) To prepare specifications for apparatus and materials used in mechanical interlocking construction.

(b) To prepare standard layouts for leadouts and lead-aways, and for connecting switches, slips, movable frogs and derails.

(c) To prepare specifications for apparatus and materials used in electro-mechanical interlocking.

(d) To confer with Committee XV of the American Railway Engineering Association as to interlocking and operation of drawbridges.

The committee submitted the following drawings:

1260—Mechanical Single Switch Layout, one F. P. L. and one Detector Bar.

1261—Mechanical Single Switch Layout, one F. P. L. and two Detector Bars.

1262—Mechanical Single Switch Layout, two F. P. L.'s, one Detector Bar and two Switches.

1263—Mechanical Single Switch Layout, two F. P. L.'s, two Detector Bars, and two Switches, spaced 3' 0" to 8' 10".

1264—Mechanical Single Switch Layout, two F. P. L.'s, two Detector Bars, and two Switches, spaced 8' 10" to 50' 0".

1265—Mechanical Derail Layout (Wharton), one F. P. L. and one Detector Bar.

The committee reports progress on the subjects of leadouts and layouts.

COMMITTEE No. 3, POWER INTERLOCKING.

Mr. R. C. Johnson, Chairman.

This committee was instructed:

(a) To continue preparation of specifications for apparatus and materials used in power interlocking construction.

(b) To continue the preparation of typical circuit plans for electric interlocking.

(c) To investigate the use of 30 volts or less for the control of interlocking apparatus.

(d) To continue preparation of plans for wire ducts, terminal boxes and manholes.

(e) To confer with Committee XV of The American Railway Engineering Association as to interlocking and operation of draw bridges.

The committee submitted the following:

Subject (a) assigned to Subcommittee "A," Mr. A. B. DuBray, chairman, presenting the following specifications:

Specifications for Annunciator Bells.

Specifications for Push Buttons for the Operation of Bells, Annunciators and similar devices.

Specifications for Floor Pushes.

Specifications for Fuses.

Subjects (b) and (e) asigned to Subcommittee "B," Mr. F. B. Wiegand, chairman, presenting the following:

Drawings 1300 to 1308, inclusive, showing typical circuit plans for General Railway Signal Co.'s and Hall Switch and Signal Co.'s Electric Interlocking Apparatus.

This committee was also instructed to collaborate with Committees VIII and X in preparation of plans and specifications for switchboards used in power interlocking. They beg to report that they conferred with these committees with the result that the conclusions reached by the joint committees was that the report of their findings should be submitted by Committee X.

Subject (d) assigned to Subcommittee "C," Mr. I. S. Raymer, chairman, submitting the following specifications:

Specifications for Steel Pipe Conduit.

Specifications for Wrought Iron Conduit.

Specifications for Installation of a Vitrified Clay Conduit System.

This committee also submitted revisions for the Specifications for Vitrified Clay Conduit, as adopted in 1912:

Subjects (a) and (c) assigned to Subcommittee "E," Mr. W. H. Harland, chairman, reporting that they made inquiries for the purpose of obtaining any information as to existing installations using 30 volts or less for the control of interlocking apparatus, but could find none. They also considered, from a theoretical standpoint, its feasibility and came to the conclusion that at the present time no particular advantage would be gained by the use of 30 volts or less, instead of the voltage now used for the control of electric interlocking apparatus.

Subject (e) assigned to chairmen and subcommittee chairmen of Committees II and III who report that Special Committee on Drawbridges attended a joint meeting of Committees II and III, Railway Signal Association, and Committee XV, American Railway Engineering Association, and after a general discussion of the subject, a subcommittee with Mr. F. B. Wiegand, chairman, was appointed to prepare an outline of "Requisites of Installation," covering both the bridge structure and signal devices, for consideration at a future meeting. This subject has not been completed.

COMMITTEE NO. 4, AUTOMATIC BLOCK.

Mr. A. G. Shaver, Chairman.

This committee was instructed:

(a) To prepare specifications for apparatus and material used in automatic signal construction.

(b) To continue on relay specifications.

(c) To prepare specifications for field work in automatic block construction.

(d) To continue on typical circuit plans for automatic block signaling covering the more simple and more common situations first.

The committee presented for submission to letter ballot the following:

Specifications for gravity battery zinc, including drawing 1087 specifications for gravity battery coppers, including drawing 1088. Drawing 1189, gravity cell jar; drawing 1313, adjustment curves (below 100 olms), four-point (D. C.) relays; drawing 1314, adjustments curves (above 100 olms), four-point (D. C.) relays.

The committee submitted for information only: Drawings 1310 A, B and C, diagrams of circuits for single track automatic block signaling; drawing 1311, diagram of circuits for double track automatic block signaling; drawing 1312, diagram showing circuits for a signal protecting an outlying switch.

COMMITTEE NO. 5, MANUAL BLOCK.

Mr. Thos. S. Stevens, Chairman.

Committee V was given the following instructions:

(a) Investigate the relative advantages or disadvantages, and relative cost (installation, maintenance and operation) of the various kinds of manual block systems (manual, controlled manual and staff).

(b) Continue preparation of rules for the maintenance and operation of interlocking plants and block signals.

(c) Continue investigation of methods of handling trains by signal indications without train orders.

A partial report was submitted at the 1912 meeting and a description of the systems to be studied was accepted and adopted by letter ballot. The plans submitted with cost were referred back to the committee because their discussion was not included. Part of these slightly revised were again presented together with discussion and a statement as to their cost of installation. These are complete in themselves and ready for acceptance. Because of lack of time the rest of the plans which were referred back were withheld because discussion could not be prepared. They will be presented in 1914.

The part of the report presented was discussed at the June meeting in New York. Several corrections and additions were suggested and accepted by the committee.

In order to simplify the consideration of the matter presented the divisions of controlled manual block provided in the description of the system are here given:

1. Check between operators.
2. Control by short track sections.
   (a) For slotting or control of semi-automatic signals.
   (b) For slotting or control of semi-automatic signals and for clearing same when train reaches station in advance.
3. Complete track section control.

COMMITTEE NO. 6, STANDARD DESIGNS.

Mr. J. C. Mack, Chairman.

This committee had instructions to continue the preparation of standard designs.

The committee submitted a review of some of the drawings previously presented, as well as the following drawings, with recommendation to be approved and submitted for letter ballot as standards:

1008. One-way Horizontal Crank stand.
1009. Two-way Horizontal Crank Stand.
1038. Base for Pipe Bracket Post.
1039A. Pipe Bracket Post.
1058. Anchor Post.
1063. Low Rocking Shaft Bearing.
1084. Pipe Carrier Side.
1085. Details and Assembly of Pipe Carrier.

1095. Multiple Unit Bolt Lock.

1099. Position of Detector Bar and Location of Clip Bolts.

1103. Concrete Foundation for Horizontal Crank and Wheel Stands.

1105. Concrete Foundation for Channel Column Bracket Post.

1108. Concrete Foundation for Pipe Bracket Post.

1223. Details of Switch Box Connection.

1225. Stuffing Box for 1" Pipe.

1226. Stuffing Box for Wire.

1239. Detail and Assembly of Switch Box Connections.

1350. Horizontal Chain Wheels.

1351. Vertical Chain Wheels.

1352. Vertical Chain Wheels.

It was decided to hold the next annual convention at Hotel Champlain, Bluff Point, N. Y., on September 20-22, 1914.

The following officers were elected: President, F. P. Patenell, signal engineer, Baltimore & Ohio R. R.; vice-president, W. J. Eck, signal and electrical engineer, Southern Ry.; secretary-treasurer, C. C. Rosenberg, Bethlehem, Pa.

Personals

Although we are publishing monthly in these columns a practically complete report of all appointments of interest to our readers, it is probable that this information could be published earlier if each subscriber would make it his business to notify us of new appointments immediately. We request and we shall appreciate your assistance in this respect.

B. W. Meisel has been appointed assistant engineer in the signal department of the *Chicago & Northwestern Ry.*, office at Chicago. He is a graduate of the University of Colorado in electrical engineering, completing his course in 1908. During the summer months while a student he worked on the signal construction forces of the Union Pacific Ry. in the states of Nebraska, Colorado & Wyoming, holding the positions of wireman and foreman. After graduation he entered the employ of the Chicago, Rock Island & Pacific Ry. signal department as a foreman in the construction forces. In July, 1909, he accepted a position as draftsman with the Chicago & Northwestern Ry. signal department, and in June, 1911, was advanced to chief draftsman, from which position he has now been promoted to that of assistant engineer, effective October 16.

E. C. Vandenburgh, formerly signal inspector, has been appointed chief draftsman of the *Chicago & Northwestern Ry.*, at Chicago, succeeding B. W. Meisel, promoted. Oscar Frohman, formerly draftsman, succeeds Mr. Vandenburgh as inspector, office at Chicago. E. Notley, formerly with the National Carbon Co., has been appointed draftsman at Chicago.

J. P. McGill has been appointed supervisor of signals of the *Cleveland, Cincinnati, Chicago & St. Louis Ry.* at Mattoon, Ill.

C. H. Lillitt has been appointed supervisor of signals of the *Grand Trunk Ry.*, eastern lines, at Montreal, Que., succeeding R. A. Becker, who has accepted a position with the Federal Railway Signal Co., Albany, N. Y.

Thos. Pflanz has been appointed signal supervisor of the *Great Northern Ry.* at St. Paul, Minn. He succeeds W. E. Shepherd, appointed supervisor of signals of the Middle district at Minot, N. D.

C. E. Denney has been appointed special engineer to the vice president, J. J. Bernet, of the *New York Central Lines*, Chicago, Ill. He left Pennsylvania State College in 1899, and from that date until May 16, 1905, was in the employ of the Union Switch and Signal Co., in various positions. From May 16, 1905, until June 1, 1906, he held the position of assistant signal engineer of the L. S. & M. S. Ry. and was then signal engineer of the same line until Oct. 15, 1913; also signal engineer of the L. E. & W. R. R., June 1, 1912, to Oct. 15, 1913.

F. B. Wiegand has been appointed signal engineer of the *Lake Shore & Michigan Southern Ry.*, office at Cleveland, O., succeeding C. E. Denney promoted. He was in the employ of the Union Switch & Signal Co., March 23, 1887, to April 12, 1891, the latter part of this time as foreman, the earlier part as a layman. On April 11, 1891, the Union Switch & Signal Co. completed the installation of automatic signals on the Harlem division of the N. Y. C. & H. R. R. R. and he was turned over to the N. Y. C. by the signal company, to maintain them. May 1, 1894, he was appointed inspector of signals and given charge of all signaling on the Harlem division, and on October 1, 1901, was appointed assistant supervisor of signals on the Eastern division, which included the Hudson, Harlem and Putnam divisions. July 15, 1902,

F. B. WIEGAND, Signal Engineer
Lake Shore & Michigan Southern Ry.

he was promoted to supervisor of signals on the River division (West Shore R. R.) of the N. Y. C., and on March 23, 1903, he was appointed general signal inspector and covered all divisions of the N. Y. C. June 9, 1903, he was appointed supervisor on the main line of the N. Y. C., Mohawk division, and July 1, 1906, he was appointed assistant signal engineer of the L. S. & M. S. Ry., which position he held till his appointment noted above, effective Oct. 15.

E. E. Adams has been appointed assistant signal engineer of the *Lake Shore & Michigan Southern Ry.*, office at Cleveland, O., succeeding F. B. Wiegand, promoted. He was educated in the public schools in Ashland and at Brown University, Providence, R. I., graduating in 1898 in mechanical engineering. From 1898 to May 1, 1902, he was with the General Electric Co., armature department; Boston Eelevated Ry. Co., electrical engineer's office; and the Gould Coupler & Storage Battery Co., car lighting and storage battery department. May, 1902, to September, 1904, he was electrical assistant, signal department, B. & A. R. R., Boston, Mass. He was appointed chief signal inspector L. S. & M. S. Ry., September, 1904, which position he held till his present appointment, effective October 15.

F. E. Baugh, formerly signal supervisor of the *Missouri Pacific Ry.* at Kansas City, Mo., has been appointed signal supervisor at Chester, Ill., succeeding E. J. Sheeren, appointed signal supervisor at Kansas City, Mo. Mr. Sheeren succeeds F. E. Baugh. Clyde O'Dell has been appointed signal supervisor at McGehee, Ark., succeeding O. R. Thurston.

The Maintenance of Way Department

PROPER OPERATION AND CARE OF MOTOR CARS VS. "FAILURES OF MOTOR CARS."

C. L. Van Auken.

The use of gasoline motor cars on railways has been recommended by many progressive officials and railways. That they are in the end an item of economy is established without doubt. The writer has, however, been on inspection work for a large railway where over 2,500 miles were covered between April 1 and September 1 and the entire distance was "pumped" on a three-wheel velocipede car by a party of three men. The time consumed in "pumping" on this trip was eight to ten times the amount of time spent in actual work. The policy of the railway in this case cannot be censured too severely. The argument was that motor cars were failures.

The success of any venture is always attended by some failures. The failures of railway motor cars at the present writing in almost every case are traced to faulty operation and improper care. Motor cars have not reached the stage where they are fool proof and it is to be doubted that they ever will.

The first requirement necessary to bring about success in the use of motor cars on railway work is to select a car that is suitable. Obviously a light inspection car should not be selected to carry four or five men and pull a speeder behind carrying one or two more men, and vice versa, a heavy section car should not be assigned to the use of two men, especially on lines of heavy traffic, but where users are not choosers the above cases frequently occur, and hence "failures" are reported.

Assuming that a suitable car has been selected, the next essential thing is that one man among the users be selected as an operator, and that this one man shall at all times run the car, instead of allowing different men to operate it each time. A car which is operated by several men is never considered by the last operator to be properly adjusted, and hence there is a great deal of useless and sometimes harmful tinkering with spark coils, gasoline feed, lubricator oil cups, etc. An emergency operator should learn to run the car, but the practice of allowing Tom, Dick or Harry to run the car here and there and everywhere should be done away with.

The man selected as operator should be furnished with a complete set of instructions, and should be competent to absorb sufficient knowledge from printed and verbal instructions to enable him to thoroughly understand the principles of the generation of power, and the mechanical contrivances of the car. If the operator's knowledge consists of "advance this lever and open the throttle," as is sometimes the case, "failure" is assured at the outset.

With almost every make of car a list of "don'ts" and "do's" is furnished. It is well to read these carefully, for they usually represent the most likely errors of inexperienced operators. Actual experience with trouble, however, teaches the operator more readily than any printed matter, provided (1) that he is able to ascertain the cause of the trouble, (2) that he can repair or overcome the trouble (except breaks in castings, etc.) and (3) that he can prevent similar trouble from reoccurring in the future.

Hand in hand with good operation must go proper care, to insure success with motor cars. With constant jar, with moving parts, and contact with oil, bolts and nuts are sure to work loose and an occasional inspection and tightening is absolutely necessary. (This pertains also to electrical connections.) Proper lubrication is sometimes neglected in order to save time, but this often proves false economy when the cylinder or cylinders "run hot" for lack of lubricating oil. With an air cooled engine the matter of lubrication becomes vital, for a hot, dry cylinder means loss of power, a permanent injury to both piston and cylinder, due to friction, which is increased by expansion of the piston from the heat generated. For this reason, double care should be exercised to prevent a shortage or loss of lubricating oil when on the road away from supply. This is the most frequent cause of needless injury to motor car engines. A good method of cooling an engine is to cut out the compression (where possible) when running at a fair speed or down grade, and allow the plunging piston to draw in cool air, and expel it with the following stroke after it has taken up heat. Lubricating oil may be mixed with the gasoline in the summer time, providing the oil is light and free from all foreign matter which might stop up the outlet. This is poor policy in cold weather, however, as the lubricating oil being heavier than gasoline, will settle to the bottom of the tank and congeal upon standing. This effectually closes the outlet and completely shuts off the supply of gasoline. In cold weather when difficulty is experienced in starting an engine, the combustion chamber should be warmed. For this purpose the surest, safest and most convenient apparatus is an ordinary blow torch, care being taken to first close throttle and all gasoline valves and to keep torch or lighted matches, sparks, etc., away from gasoline storage or inflammable materials.

Oil and grease, with their attendant accumulation of dirt and grit, should not be allowed to gather around oil or grease cups and oil holes. Grinding caused by dirt and sand in running parts causes more wearing away than the lack of proper oiling in the majority of cases of railway motor car operation. Accumulation of oil and grease on the wooden portions of frame also increases the danger of fire and disaster during the use of blow torch in winter for warming combustion chamber. Danger of fire from overheated cylinders and soiling of clothing are additional reasons for keeping exterior of car clean from oil and grease. Looked at from the standpoint of safety, we may cite the ever recurring case of the unexpected "extra" appearing suddenly around the point of a curve. Quick action and accurate movements are absolutely necessary to "get in the clear." At the critical moment, with the car poised and almost in the clear the hand loses its hold, due to accumulated oil and grease at the point at which the car was grasped in emergency.

Exposure of cars to inclement weather while not necessarily acutely dangerous, should be avoided in all cases, especially as the only equipment necessary is a few square yards of heavy waterproof covering such as a tarpaulin. Continued rain or snow, especially with a driving wind, is certain to cause trouble somewhere. Proper care of a motor car does not consist, however, entirely of preventives. When a car appears consistently to lack its usual power, it isn't a candidate for the junk pile nor necessarily a "bad order" case for the shops. A complete overhauling and cleaning is more often all that is required, and this can usually be done in a few hours' time with the ordinary available kit of tools and equipment.

From observation and experience, the conclusion is that so-called "failures" are not failures of the motor cars themselves but rather failure of operators due to lack of proper care and operating ability.

RAIL CREEPING.

In continuation of my letter on the subject of rail creeping, I beg leave to mention some more of the causes which tend to affect creep:

(24) Too frequent change of gradient.

(25) Too many curves.

(26) Maintenance of the gauge of the road with regard to the wheel gauge.

(27) Inclination of rails in relation to wheel tires.

(28) Suspended or supported joints.

(29) Defective construction of load run over the track.

(a) Axle not true.

(b) Axle guard not set square under frames.

(c) Play in axle guard too little or too much.

(d) Play in brass and bearings on the journals.

(e) Weakness and hardness of springs of cars in their relation to each other in same car.

(f) Center of gravity of cars not in the center of track on a level road.

(g) Center or side bearings of cars.

(h) Construction of locomotives, and many other minor causes which are too numerous to mention.

The wave-like motion mentioned in my last is only the effect of compression and tension to which the rails are subjected by the passing load. If this is not visible, then the alternate sleepers may be loosely packed and the elastic wave will soon be visible. The rail should be considered as a continuous girder fixed and supported on each tie; the effective span is the distance center to center of ties, whose head and base are subjected to alternate tension and compression; but the former is not visible as the load moves rapidly, for when the wheel is on a tie, then the upper head is in compression and the lower in tension, while on the adjoining tie on each side of the load the upper head is in tension and the lower in compression. The driving wheels of the locomotive throw the creep backward in the opposite direction of the moving load, in proportion to the tractive force exerted, depending upon gradient, total load to be pulled, elasticity of rails, roadbed, friction of wheel, journals, radius of curve, speed, diameter of wheels, etc., etc. The other following wheels of the engine, as well as of the load, try to throw creep forward, depending upon load, gradient and up-keep of the road, elasticity of rail, number of ties in a rail length and anchorage of ties in ballast, grip of fastenings, etc., etc.

Whenever the load moves over the track there is action and reaction in crushing and springing of the road to its former position; this springing is partially due to tie sinking down, deflection of rail, grip of fastening, etc., etc. The tie springs with the rail, if well fastened, and along with the wave of elasticity tries to move with the creeping rails. You well know that all the ties in the road cannot be uniformly packed; but, granted that they are uniformly packed, some of the roadbed will sink or be more elastic than the other part of the roadbed. If we do not have elasticity, the rail head, wheel treads, journals, brasses and ties wear too rapidly.

The springing generally depends upon section of the rails, grip of fastenings, nature and kind of ties, roadbed and ballast, i. e., in the elasticity of materials employed in construction of the track. Passenger locomotives have leading truck wheels of smaller diameter; this is especially intended to steady the waving motion of the rails just like a launderer's iron on a cloth. Also, it guides on a curve because the wheels, being of smaller diameter, require less elevation of the outer rail than the wheels of the larger diameter, and a truck tends to change direction immediately, radially to the curves.

The phenomena may be observed as follows: Take a flat bar or bars of iron, the longer the better, place them on two supports some distance apart, and then subject these bar or bars thus supported (1) to a light small diameter rolling load with slow speed; (2) same load with fast speed; (3) large diameter of rolling road with slow speed; (4) large diameter with high speed; (5) heavy load with small diameter with slow speed; (6) heavy load with small diameter at high speed; (7) large diameter and heavy load with slow speed; (8) heavy load and large diameter with high speed. The bars can be put at different inclination, setting them for different curves and gradients.

I am of opinion that if the grip and anchorage be firm the creep may be obviated.

STANDARD TRACK-WORK SYSTEM.

By Earl Stimson, Engineer Maintenance of Way, Baltimore & Ohio R. R.

There has been developed on the Baltimore & Ohio R. R. and applied on its Philadelphia division, a system of direction and supervision of maintenance-of-way track forces which has resulted in more uniform practices and increased efficiency of the organization. This has been accomplished by the establishment of standard schedules, indicating uniform practices of the various items of track work, and by keeping a daily record of the performance of each gang. The per cent relation of the actual performance to the standard schedule is the measure of each gang's effectiveness. By a tactful use of the information thus derived, and by reason of the instruction secured through study upon the establishment of the standard methods, the supervisors have, month by month, increased the performance of the gangs on their territories.

The development of the system has been in progress for two years and is now perfected to such a degree as to admit of practical application with gratifying results.

To start with, the principles of efficiency as outlined by various authorities and experts on shop practices were used in the formation of a method which would be applicable to the maintenance-of-way work. This plan was carried forward and developed by the division engineer and his organization, under the direction of the engineer maintenance of way. It was at once found necessary to develop the following features:

1. Accurate standards for each item of work.
2. Simple forms for recording performances.
3. Instructions for foremen, to enable them to submit accurate reports of performances.
4. A uniform and consistent measure of performances of gangs, kept by assistant supervisors, and the use of comparative results and standard methods to improve efficiency.

Standard track-work schedules have been made up as a result of the time studies of the various items of maintenance-of-way work. These studies were made by the assistant supervisors and represent actual performances of certain gangs using standard methods under normal conditions. Before the standards are adopted, they are carefully reviewed by each assistant supervisor, each supervisor, the assistant division engineer and the division engineer, and then submitted to the engineer maintenance of way for approval. In addition, a thorough review and discussion of each item takes place at the division engineer's monthly staff meeting, in order that there may be no question raised as to the accuracy of the determinations.

Forms.

Six forms are used in carrying out this system, as follows:

1. Dispatch Sheet.—This is used by the supervisor to outline for each section each day the work upon which that section should be engaged.

2. Rules for Reporting Time Charges.—This is for the government of foremen in reporting the number of hours spent on each item of work each day. These are reported on the daily time report heretofore in use; and noted thereon, in addition, is the number of the dispatch sheet upon which they have been working.

3. Daily Time Distribution Form.—This covers each item of work, there being one for each gang. The actual hours consumed and the standard schedule for each item of work upon which the gang was engaged are noted. The result of each day's work is taken from the time report by the assistant supervisor each day upon receipt thereof, and placed on the form. At the end of the month, totals are readily added and the measurement of each gang's efficiency prepared.

4. Form Giving Monthly Totals.—This gives the monthly totals for each section of a subdivision, covering each item of work. It enables the keeping of a summary of the efficiency of each section by subdivision, and represents the final measure of that efficiency.

5. Record of Track and Roadbed Features.—This form gives a tabulation of all features on each section which require expenditure for maintenance, and is prepared in order to have a basis for the equitable distribution of labor and material.

6. Track Condition Sheet.—This form is used for the notation of the changing conditions of the physical features of the track and roadbed in order to provide a basis for the proper distribution of the force to meet the changed conditions.

Advantages of These Forms.

A brief résumé of the advantages of these forms will explain the working features of the system.

The dispatch sheet enables and requires the supervisor to direct each foreman. The duplicate copy, which is retained on the dispatching board in the supervisor's office, permits consideration of the progress of the work and the more intelligent planning of future work. The division engineer, or other officer in charge having access to the board, is kept in close touch with the work.

The rules for reporting time charges are self-explanatory. It is apparent that such rules must govern the foremen in reporting time charges, in order that uniformity of record will prevail.

The daily notation of the time distribution of each section gang gives to the supervisor a daily record of the performance and efficiency of each gang on each item of work upon which it is engaged. The value of this is evident.

The monthly totals for each section give the supervisor an absolute record of the accomplishment of work by each foreman. The ability of the foreman or gang is, therefore, a matter of record, and is not merely a speculation.

The track and roadbed feature sheet affords a basis for the equitable distribution of the force necessary to maintain tracks in a uniformly good condition.

The track-condition sheet provides for notation and derivation of changing values of track conditions each month, enabling a redistribution of forces in accordance with the changed conditions. This form is an auxiliary to the track and roadbed feature sheet, which includes the fixed characteristics. The track-condition sheet takes care of the varying conditions.

Bonus System.

Sequential to the establishment of standard methods, standard schedules, and measurement of performance of work, is the reward for increased effort. So far, any incentive toward improving the performance has been dependent upon the rivalry between the foremen to bring their averages up to the highest figure, accepting the accomplishment for their record. This may be effective to a certain degree, but it is felt that there will not be the progressing and permanent increased efficiency desired unless some tangible reward for increased effort is offered. This can be done either by the distribution of prizes or by the adoption of a bonus system based upon the record of performances.

As accurate standards and equitable measurements of performances of the various gangs have now been established, the adoption of a bonus system which is so arranged as to reward the men in the gangs according to their average efficiency is thought necessary to produce the maximum results. Such a bonus system has been worked out and will in the near future be put into effect. This system may be summarized under four general headings—standardization, instruction, planning, and reward.

Standardization.—The standardization is brought about by the compiling of standard-track-work schedules, based on actual time studies of work done by standard methods under normal conditions.

Instruction.—The set of standard practices and methods having been adopted, the instruction of the foremen in these practices and methods will make for a uniformity of performance and increased efficiency.

Planning.—With a set of standard schedules of actual performances at hand, the intelligent determination of the amount of time necessary to perform each item of work is readily accomplished, and with this information the accurate planning of a scheduled routine of work is a matter of computation.

Reward.—The standard schedules derived, the imparting of them to the foremen accomplished, and the work planned in a sequential manner, its accomplishment in the shortest length of time with the least labor waste is a matter of supervision. There comes a time when supervision has reached its limits. It is then necessary to offer an incentive in the form of a substantial reward.

The planning, dispatching and the keeping of the detail records is done by the assistant supervisor working in close contact with the supervisor. The assistant supervisor is a young man selected from the engineering corps. The position thus forms an excellent training school for future division engineers. —Engineering Record.

USING SCRAP RAILS AS ANCHORS FOR TRACK THREATENED WITH WATER.

W. Krichbaum, Supt. Track.

From my experience with high water I would say that there are various ways and different conditions which we are often compelled to meet during periods of flood. On a great many railways washouts are a thing never looked for ahead of the real experience, which makes it very inconvenient to handle them properly.

To commence with, any railroad that is subject to high waters should at all times, have near at hand, a goodly supply of large sized crushed stone, which can very quickly be rushed to the place of trouble. Where stone cannot be had, gravel is very good, but where current is swift it must be placed in sacks or bags to accomplish results. For applying to track that is being threatened by water, start a work train (with plenty of laborers to handle work quickly) and spread the coarse stone out over the track, level with top of rails, and let it extend over the sides of the banks. And you may rest easy in the conviction that the track will remain in the same position if it does get covered all over with water. When water recedes you will find your track very little damaged from the effects. Where coarse slag or stone can be had it is very good to form a complete riprap with; but in a great many cases such stone cannot be had. If at any time the track becomes submerged and liable to slide from grade, a very good anchor can be made quickly by twisting wire together forming a cable; fasten one end of this to the track and the other end to a loose old rail of any weight and slide it down to the bottom of sub-grade. Apply as many of these anchors as are necessary to hold the track from being swept off top of grade—it will be surprising what they will hold.

Any submerged track that has given trouble can be greatly improved by planting willow twigs at intervals of say, 4 feet along the bottom and up on side of slope as far as grass line extends. After one year's growth you can keep them mowed off close to the ground, and each year they root down further, making a very firm protection against washing. With the willow planting comes objections from some officials for the reason that they do not make a very tidy appearance when let stand too long without being mowed down. But experience has taught me that we must at some times drop the idea of beauty at some places.

At all openings such as sewers and arches a close watch must be kept at all times to prevent rubbish from accumulating. This can be noted by the supervisor on his inspection trips, as some foremen will be very negligent on this important part of the duty they should at all times perform at bridges or culverts.

A careful application of riprap should be made during low water periods, placing large stone at the bottom of grade and continuing toward the track with flat rock or coarse furnace slag. Do not hesitate on account of the cost of this work as

it may mean thousands of dollars gained later.

Around bridges and buildings, I would recommend that rip-rap be made doubly strong, and no willows or other shrubs be planted near, as after they are mowed down by the maintenance men, they sometimes are left and dry for several days, section men not thinking what an expensive fire might start. In this day we have to work an indifferent class of men on our tracks, and the official should and must at all times, use great judgment and foresight.

When water gets high it sometimes becomes necessary to dispense with traffic for a day or more. In such cases loaded cars should be placed on all bridges that are in danger of being washed away, as this extra weight will many times hold a bridge to the abutments, while if it is not done the bridge being struck by a floating log or other heavy drift, will loose its anchorage and will be washed away. In case of washouts the proper time to stop washing is before it begins to wash, and it is always much cheaper to do this way. But as I have before stated this part of it is very often neglected. For a steady rise of high water I have never found anything better to keep track and road bed in proper position than the coarse crushed stone spread over and about sides of track as in nearly all cases the first parts to give away will be between the ties and when once started it is surprising how quickly the entire grade will let loose.

In using crushed stone, if it is not the desire of the company to let it remain where spread, it can be gathered up and re-used where needed. But it is always a very good plan to have the necessary material close at hand so as to cause no delay when needed.

SECTION AND EXTRA GANGS.

D. C. Davis, Roadmaster.

From personal observation and experience I find that there is frequently a section which for many reasons may get behind with tie renewals and other work. Sometimes it is the fault of the foreman, but more frequently it is due to some other cause over which he has no control. There are places on some sections where water does damage and frequently makes small washouts which have to be repaired, and the allowance is so small that no additional help could be given. This forced work is done at the cost of the track, leaving it to get rough, and entirely too often the blame is placed on the foreman who was forced to do this outside work.

Then we have localities where, during certain seasons, other industrial and farm work pays more than we are permitted to pay, with the result that it is almost impossible to get help to do emergency work, and the section is permitted to run down, but not without regret and efforts of the foreman to keep it up.

Now these are some of the causes for poor and rough track, and some means must be devised to restore the track to normal condition. I have never found any better way than to have a floating gang of from 10 to 15 men, with tools, and turn them over to the foreman until he gets caught up, and then shift them to the next worst section. By this arrangement I have always gotten better results than by extra gangs, for the section foreman will try and do his work as permanently and substantially as possible, while an extra gang foreman, as a rule, will try and make a record. With some inexperienced laborers and others who don't care, we find the work poorly done, ties not accurately gauged, loosely tamped, and improperly spaced, without adzing to make the tie fit the base of the rail. The result is that the track is commencing to get rough before the work has been completed, and has to be gone all over by the section force before there is any decent track. All we can find accomplished is the ties put in, and perhaps some small amount of ditching done, and a few places shouldered up. By having this done by the section foreman we would have saved first the wages of the extra gang foreman, and if a large gang, the wages of a time keeper, the time of going over the same work gauging adzing and surfacing and spacing ties to say nothing about the loose bolts and tie plates having to be looked after. In this connection permit me to say that many a foreman is entirely too severely criticized and driven almost to despair, knowing he has done everything possible to hold his track up to an average with other sections, and he regrets more than any one the track conditions which he had no way of preventing. A man making this kind of struggle should be kindly spoken to and encouraged for the strenuous efforts he is making.

There are times when an extra gang can be used to profitable advantage, such as repairing after washouts, heavy ditching and bank widening, putting in ballast to a certain degree, re-laying steel, and constructing tracks where much is to be done. Heavy ditching can be done by extra gang and thus permit the section foreman to keep up his track and tie renewals.

Even after an extra gang has gone over a job the foreman will have to go back and do a lot of finishing work, but not necessarily at a loss as the main part of the their work will be sufficiently well done. The placing of ballast could and should be done by extra gang, but the final raise and finishing should be done by and under the supervision of the foreman of the section, if a competent man, by giving him enough extra help to carry on the work, allowing the same rate of pay that the extra gang men are paid. This would make a big saving and result in the track being properly gaged, lined, and surfaced, with all other work correctly done in connection with ballast completion.

The same can be done in steel laying. Have the laying and loading of the old rail done by extra gang and leave the finishing work of gauging, tie plating, spacing ties under joints, full bolting and all minor things for the section foremen to finish in order to get the best results and a substantial job that will not have to be worked over, (in too many instances by the section force of regular size). When such work is left to be completed by an extra gang, the general opinion is that the work is complete and that the foreman should be able to maintain and keep up his track in better condition with the new steel. But on examination we invariably find that the gaging was poorly done, being tight at places and loose at other points. The bolts will be only partially tightened. This condition is brought on by the foreman trying to make a record or do as much as some other man had done, with all kinds of laborers, some not knowing how, while the rest do not care.

As to surfacing, it is next to an impossibility to get an extra gang to do any tamping. It is true that there are a few old timers that do their work well, but this in many instances is detrimental, as what they put up will stand and the rest will go down and leave an uneven surface causing a roll which gets worse as each train passes over, and there is no remedy but a general working over by the section forces.

This being invariably the result, then why not give the section foreman enough help at the same pay and let him have charge and do the finishing work, get a completed job done at first and save the extra gang cost.

I have had direct charge of laying steel and placing ballast on new work and have never been able to get the work done as I would have liked on account of the variety of laborers that I was compelled to work, and watch as close as I could I would find slighted work. This was more noticeable in surfacing, for while the good workers got their ties well tamped, others on the same panel would barely fill in the ballast, with the result that part would settle too low while the rest stayed up. We were unable to do much back work and get up what was considered a reasonable number of feet to the man, so for this reason I would turn over the last raise and finishing to the section foreman.

The most successful and satisfactory steel laying I ever

had done was a 54-mile stretch with 10 miles of rails to be curved. I organized two gangs of from 40 to 50 men and had them adz and lay the steel and make it safe. Then each section foreman was allowed 10 to 15 men each and did the gauging, bolting, spacing of ties, surfacing, and all completing work, and in this way I soon had the track completed and did not have to start the section gang back over the work as soon as the steel was laid. The pay of the section men was raised to that of the extra gang until they had got over the section and then it was reduced to the standard and the extra help allowed was cut off. In this way it was my opinion that I saved the cost of the extra gang on finishing work, as I consider at least two-thirds of this finishing work a dead loss if done by the extra gang.

We are at an age where the man that can lay the most rail, surface the greatest number of feet to the man, or put in more ties than some other is considered a valuable man, and those who are not familiar with the kind of work done, take this to mean completed work, and establish a fixed price per foot or mile. Then a foreman who does not accomplish about this much work is considered incompetent, something no one desires, so he has to do the same kind of slighting work.

I have known where an extra gang under the supervision of a man claiming to be a civil engineer, relayed 20 miles of steel and never used an adz. He set the steel up on the end of the ties, and it being about as much curve as tangent, when throwing in the steel on inside of the curve, the rail drew apart and the outside closed up, making one side tight and the other loose. Tie plates were driven under the rail from the inside without adzing off any of the old shoulder of the worn down tie.

After getting the track laid, the division was turned over to me and I had to virtually overhaul every foot, making what work he had done a total loss except placing the rails on the ties. This does not properly belong to the subject, but merely shows poor supervision of work and the after results.

A section foreman lost his position a few years ago on account of rough track after it had been reballasted by an extra gang. The roadmaster was complaining to me about how this foreman was permitting his section to go down and I told him that there was only a galvanized work done and it was no fault of the foreman, but he contended that he watched the work and knew the ballast was well put under. About one year later, however, it was necessary to do work on this section and when I uncovered the ballast and he could see that scarcely anything had been put under the ties, he had to confess that the extra gang man had slighted the work.

As to bunching section men to put in ballast, lay new rails, or put in new track, or any other kind of one or two days jobs, I am decidedly against any such work. It is detrimental to any section to have the men taken off and the track made to suffer in ratio to the time they are away, as there is rarely any section that has force enough to maintain what they have and keep the track up to a standard. And every day the gang is off it is so much loss that cannot be caught up without additional help. This loss may not be noticeable to the mass of people or train men, but there is always some defect develops that would never have occurred had the force been retained daily at its own work. This is not the only loss either, but there is lost time in having gangs going to distant points. They are bound to lose time or put in overtime for traveling.

As to the ability of section foremen to handle work of ballasting or relaying steel, I would say that most of them are as capable as necessary to attend to the finishing part with a small force, not more than 15 men, so that they could properly supervise the work and see that it was done in as permanent a way as practical.

A section foreman that could not perform this kind of work would not be a suitable man to keep, for it would surely be a poor man that could not beat the general extra gang work the way it is turned out.

I have never had an occasion to go outside of my own track district to get men that could handle anything that came up, by properly instructing them in the way of working and distributing their force to get the best results. There is more in organizing and keeping a gang organized than would be at first considered. No foreman can accomplish work and have his men scattered, first at one thing then another. Place them where they are most suited and keep them with that work, and soon they will understand and can do it much quicker and in a better way than by shifting around. I believe most intelligent men can readily see how to properly place their men and keep them all at work.

SAFETY WORK ON THE PENNSYLVANIA R.R.

The Pennsylvania Railroad Company has during the past year devoted particular attention to perfecting its organization for safety. Safe operation has always been the prime aim, but special and intimate study is now being given to every element in operation which might lead to an accident, even indirectly.

The methods by which the management follows up all questions of safety is indicated in the following statement:

On each division of the Pennsylvania R. R. there is a regular written program for handling wrecks. A designated officer of each department goes to the scene of each accident and a joint investigation is made to determine the cause. The results of the investigation are embodied in detailed reports. These reports pass through the hands of the superintendent, the general superintendent and the general manager. The superintendent takes such action to prevent repetition as may be deemed necessary. The general superintendent checks the work of the superintendent, and finally the general manager, through his accident bureau, makes such deductions and draws such conclusions as may be warranted by the facts shown in the reports. This is followed by recommendations which may involve the improvement of machinery, change in methods of operation or the efficiency and discipline of employes.

All reports, both of personal injuries and train accidents, are tabulated and summarized. These summaries are issued quarterly and yearly and provide the officers with data suggestive of remedial measures. The summaries are also distributed among the men, who receive in that way information as to the experienced thought of the management.

The motive power department is provided with full and complete information as to the number and cost of accidents resulting from motive power defects. Constant and elaborate study is made by this department of the condition of material and the practicability of designs. Changes in unsatisfactory equipment are being continually made. What is said of the motive power department applies also to the maintenance of way department.

The operating department is furnished with figures showing the number and cost of accidents resulting from negligence and inefficiency on the part of operating employes, and such measures are taken to improve the service as may be suggested by the statistics.

In addition, the general manager has a discipline committee, composed of three experienced train-masters, who have devoted their time since 1911 to the examination of discipline records of employes in all departments. This committee makes recommendations regarding the condition of records and the manner in which the records are kept. They call attention to the cases of men whose records indicate that they are below a reasonable standard of efficiency, special attention being paid to violations of safety regulations. It is the purpose of the management to place itself in a position to be able to determine, from the written records of the men, whether they are rendering safe and efficient service.

The train rules committee is constantly passing upon pro-

posed rules and regulations and changes in the present rules and regulations.

The dispatching committee is composed of five practical subordinate officers, who have been examining into methods of operation on all divisions of the railroad for more than four years. This committee at frequent intervals visits the division headquarters and goes over with the superintendent, division operator, trainmaster and dispatches all questions relating to the interpretation and application of rules and regulations pertaining to the movement of trains. Any cases of misinterpretation or failure to apply the rules in the prescribed manner are promptly corrected, and such other recommendations are made as may be suggested by the interviews with the division officials. The work of the committee is intended to bring about uniformity as well as safety in the introduction of new rules and the application and interpretation of the old rules.

On each division there are one or more safety committees which inspect the road, yards and shops to see that the equipment is in safe condition and that machines are properly guarded. There are one or more efficiency inspectors on each division who make tests on the observance of the rules and regulations of the company. An average of approximately 500,000 observations and tests are made monthly.

Briefly stated, the management is making a concerted effort to develop the operation of the road to the highest possible standard of efficiency and safety, and to this end all departments are co-operating.

WASHOUTS AND FLOODS.

C. Clay.

In the eternal cycle of passing from a body into vapor, being transformed into water again, falling to the earth and reaching lower levels until it again becomes a large body collected in a depression of the earth's surface, water like all fluids follows the line of least resistance. Generally the first resistance that it meets is not of sufficient magnitude to impede its flow until a railway is reached. If there are insufficient openings or bridges in the railway the water is held back and rises until it flows over the track. Another type only met in the mountains is where there is a cloudburst on the top of a hill and a railway has a track over the top; then the water will follow the track in both directions until such time that it reaches a point where there is an arroyo to carry it off.

Prolonged rains in the mountains do but little damage owing to precautions taken, but they surcharge the rivers which causes flood conditions and washouts on railways at the lower levels. In one way washouts on the lower levels are more fortunate as they usually can receive warnings of flood conditions, whereas in the mountains there is but little warning. Practically the only protection in the way of warnings in the mountains is the gathering of clouds in the vicinity or around some peak near at hand. Therefore it should be an inviolable rule that whenever there is a storm or indications of a storm, section men be required to patrol the track. This does not mean that one man should take a lantern and walk off into the storm, but that the gang should go. It looks like an extra expense to send a gang but in case of a washout, one man would be practically useless even for flagging.

It appears to be a hardship on the foreman to expect him to get out and patrol track during the storm. But it is a necessity and it is rarely a foreman is found who sends a man and shirks a duty of this nature.

When starting out it should be required, where office hours permit of this, that the foremen send a message to the trainmaster and roadmaster stating what the weather conditions are. This will permit of the trainmaster placing such orders as he considers necessary and consistent with good operation.

Trainmen too, should be required to keep watch for extraordinary conditions and report them. High water in some localities is very possible at a bridge, unknown to the section foreman.

In the examination of a man for the position of section foreman too close an examination on the inspection of track, in cases of this nature, cannot be given and a proper and adequate inspection should always be insisted upon where the conditions warrant. Where it would seem that a necessary inspection has not been made, it can be easily shown where the foreman is required to report before and after patrolling his track, by the lack of such reports.

Erosion by the current of a river running alongside the track can generally be guarded against as the point at which a washout is likely to occur is plainly shown before any serious damage occurs. This can be protected by the use of brush mats and riprap, or where the bank of the river lends itself to this, by the use of a reinforced concrete apron. As a temporary measure in an emergency, sacks filled with dirt can be placed along the bank to good advantage where a river is cutting in. The current can be diverted by placing riprap out into a river so as to prevent it cutting into a bank, but where this is done care must be used that the current is not diverted so far that it will injure land not owned by the railway, as in that case there is a liability for damages. The diversion of flood waters is frequently the basis of damage suits brought against railway companies, so that when taking protective measures against high water, care should be used in the study of conditions to avoid any damage to neighboring land. Very frequently one will meet with a case where a farmer claims that the diversion of water by means of ditches to one bridge has caused the flooding of his land, which lies on the lower side of the bridge. Where the natural drainage is toward the track and above a bridge, that water can be diverted to the bridge by means of dykes. Although the construction of a dyke would appear an unnecessary expense where the railway is on a bank and this could be protected by riprap, the diversion by a dyke has the advantage of preventing the water from reaching the railway bank and softening this by the amount that would seep in.

Naturally, local conditions must govern, as it is impossible to make a general rule for all conditions. Where the material in one bank would be of a class that would make the seepage of water into it slow, another might be of a light sandy nature and very pervious. In some places the earth used in banks, which of necessity is local to avoid long hauls, is such that prolonged rains will seep into it and soften it so that it slides. In any case where surface water seeps into the roadbed, it causes it to soften, with the attendant damage to the surface of the track above. So that where protection is made against washouts, it is often a greater saving to construct a dyke at a short distance from the track, and riprap that rather than to riprap the actual material upon which the track rests.

Owing primarily to locating lines so that the cost of construction would be low, a large number of railroads have been located by the sides of rivers so that the advantage of their grade might be taken. In some cases where this has been done, there are steep bluffs with probably a mile of bottom land betwen them and the river. The railway being built on this bottom land generally has not a sufficient height in the bridges to carry surface water draining off these side hills during a heavy rain, as the track is placed on the level of the surrounding land. In such a case, when a heavy rain occurs, the track is inundated. Even though the water does not do any damage, there is always a residue of mud left between the rails when the water drains off. It is an expense to clean this mud off and such inundation might be avoided by the use of dykes. But this bottom land is valuable for farming and to build dykes would divert the water to the damage of the farmers, so where this occurs the railway is often helpless to prevent the water from flowing over the track without facing damage suits. Where the water flows over the track in

this way it generally eats away the shoulder on the side upon which it leaves. Where there is a constant recurrence of this it can partly be obviated by the placing of small riprap, flat pieces about six inches, or large flat stones, along the shoulder and from the ballast to the edge where the shoulder is exposed to such action. Where the damage suits from dykes would be large, the banks are not high, and there is sufficient vegetation, there is but little damage from the water flowing over in this way with stones placed along the shoulder; but it is not advisable to face the danger of such flow any longer than necessary.

Vegetation is always a help on the side of a bank, and that with long roots should be induced to grow. In selecting vegetation for this purpose, care should be exercised. According to report, some years ago a railway in France while attempting to vegetate its banks used poppies, with the result that they spread over the surrounding country to the damage of the residents.

Vegetation on the slope of a cut will also help to hold that against the action of rain. Where a cut is on a grade, especially where there is a low bridge at the upper end, there is a danger of having flood water drain through the cut, and in that case the ditches should be as wide and deep as possible and kept clear at all times so that the water would be kept from reaching the ballast. When flowing parallel the water will cut the ballast from under the ties, if it raises as high as the ballast.

Where a cut is on a sufficient grade to give a current to surface water flowing through, it is advisable to place small riprap on the side of the ditch next to the track to prevent the water from widening the ditch toward the track and washing out the dirt from under it.

With the torrential rains of the South-west and the soft sandy soil found in some places, there is always a danger that flood water from the hills will follow a new course and not the old arroyo in getting to a river. The sudden flow of water, even down an arroyo, under such conditions very often resembles a tidal wave. When this follows some other course it practically carries everything with it that it meets, including any railway track that may be in its course. A study of the topography of the surrounding country might be of some assistance in guarding against the point from which damage may arise, but it is doubtful. The only safeguard against such conditions is the patrolling of the track as mentioned before. There are undoubtedly many locations where the water has caused damage where it was not known to before, cases of this kind occuring every year. When such an instance occurs, an observation as to the location of the storm and an investigation as to other conditions surrounding it might help to prevent a recurrence. Where these sudden storms are likely to occur it is advisable to have, during the warmer months, such material loaded and ready to move as might be required.

It is difficult to say what should be held as this would vary with local conditions. There is too, the cost of tieing up the equipment and to have too much tied up with emergency material is an unnecessary expense; yet to have not enough means a greater expense in repairing the roadbed. But one car loaded with rails and cross ties, about thirty cars loaded with riprap and others with bridge material ought to be sufficient to protect against any sudden call, where located centrally, for about seventy-five miles either way. This would be too large for some locations and too small for others, but will serve as an average. Where a track is located along a river from which there is danger of high water and the cutting of banks, it is good practice to have a supply of sacks distributed along so that at the first sign of cutting, these can be filled with dirt and placed on the bank until more permanent steps can be taken.

It would not be consistent to tie up any equipment loaded with material with which to build cribs, as generally speaking sufficient can be picked up in the immediate vicinity of a washout or without any very long haul. Nor would it be consistent to tie up equipment with material to cover a washout that extends over any distance. The amount would be governed by local conditions of course, but enough should be available to start work with in the case of a large washout. A large washout rarely if ever occurs at a point where there is a large force of men, fully equipped, and if there is enough material to start work with, you will be able to form an estimate of what is required and have this on the way by the time that you begin to concentrate your men.

After a washout occurs the first thing to do is to get the traffic moving, and every washout submits some special phase that does not appear to have occurred before except in a general way, so that but little can be said on this. Possibly it is better for each individual case to be met at the time it occurs rather than to have a special idea of how a wash of that description should be repaired. If a parallel to the track wash, it can generally be temporarily overcome by lining track over, building a shoo-fly, cribbing, or something of that nature, until the track bed can be rebuilt. If at right angles and not too deep it may be repaired by filling, making a sag until it can be brought to grade; or if too deep, by cribbing and then rebuilding the bank; or if found necessary, by building a pile bridge.

While the public clamors for high speed, they would clamor still worse at a passenger wreck in a washout. So it is preferable for trains to lose time rather than to follow a schedule when conditions are such that it would be dangerous.

Too much stress can not be laid on having the section men patrol track when conditions are uncertain. Their patrolling should not relieve the train crews of any necessity to keep a sharp lookout, as even though the men may have passed a spot which did not appear to be the least dangerous, there is a possibility of something happening behind them.

IMPORTANCE OF GOOD TRACK MAINTENANCE.

C. B. Britt, Supervisor.

With regard to maintenance work, I am forced to acknowledge that I hold views somewhat different from the majority of men in position superior to my station. I have been in track service since 1877, commenced as section laborer, was several years foreman on various track and section work, and have been supervisor for sixteen or eighteen years. My idea is that all men are created equal, but they are not equal in all things. Men are similar to machines; for instance, a turning lathe is of no use as a planer. Men are the same. A man trained for a jeweler is of little use for a doctor. While a man may be the finest educated in the country for an engineer, there is no question whatever that all he may know is how track work should look after it is done. And then after track is built he can go over it and pick out irregularities. But his eye has not been trained to catch at a glance defects that cause accidents, due to bad track, that an experienced trackman would detect.

Newspapers report daily, accidents caused by bad track. Dangerous conditions would be noticed by an experienced trackman. For instance, it is a fact known by all trackmen that the gauge of track does not widen in a short space of time. The same is true of a defective rail, except straight breaks. Elevation of track, as well as line, shows indications months before it would cause accident, except on slides or fills which give way in wet weather. Crossties do not rot out in one day, but show weakness at least one year before an accident would be caused. Switches, frogs and guard rails will show indications for a long time before an accident would take place. Of course, occasionally cases do occur where anything would break.

Therefore I have been and am of the opinion that as all men train themselves for their occupation or position, that a practical trackman should be selected for a roadmaster or a supervisor. The selection should come from a man who has been noticed for the care he has taken of his section, and not that alone, but also see if any accident has ever occurred on his section due to bad track that could have been avoided. While commissioners

hold the management of a road responsible for accidents due to defective track, I am of the opinion that no one higher in position should be held than the roadmaster, except it be shown that material was not furnished, and that he called attention to such spots, as well as notified all concerned for trains to be on the lookout for this spot. In connection with this, all roads should have a set limit for rails to be worn down to; track should not get wider than certain amount; elevation should not change over a certain amount in certain distance; crossties will show for themselves.

As to selecting a foreman, it is most desirable to pick out a man who has had some experience, and has showed indications from his work that he knows how to do the laboring work, and then make the appointment. The roadmaster or supervisor in walking over his section with him need say nothing, but will see in short time the notice the foreman takes of various defects that would after a time cause accident. A supervisor or roadmaster should be kept out on the road the entire time, examining track and looking into the work being done; in other words, he should be trackwalker as well as master of the work throughout, and above all see that there was no defect that could be detected by a man of experience on the work.

When all sections have equal advantages I am in favor of handling larger section gangs to do the entire section work, except rail laying. I do not favor combining section gangs, except when conditions would demand this, but keep check on each gang's work as to amount done and conditions of work when done.

Work done by extra gangs generally is done by foremen who have not had the experience of section men. All men are not as careful as others. Some extra gang foremen are after show, while others are after lasting qualities.

As to the track condition and cost to the company. I cannot see why there should not be an ample force to keep line and surface in as near perfect condition as could be done by man. You might ask why, which could be answered in this way: Should a car be left on some side track it would last a long time; should a car be run over a perfectly smooth road, there would be no jar or twisting to strain or wear anything other than the thread and journal; therefore a car would last a long time. But should a car be run over a road that had bad surface and line, it can easily be imagined that the strain on all parts of the car is great. Therefore the first requisite of a railway should be good track. Everything else should be second, but by far the majority look at the track last.

MAINTENANCE METHODS.

V. H. Shore, Foreman.

In regard to maintenance wholly by regular section crews as compared to maintenance by section crews assisted occasionally by extra gangs, I would prefer the former both for efficiency, if it were at all times practicable. Sections often get run down on account of scarcity of labor, which necessitates an extra gang later when help gets more plentiful; but if regular section crews can be kept filled up, with a reasonable allowance of men under a competent foreman, it is a better plan because the work is more efficient.

Take for example a division that has been allowed to run down and put one or more extra gangs on it to put it back in normal condition. To begin with, we have a lot of inexperienced laborers as a rule, and no doubt foreman unacquainted with the road bed in that section of the country. A foreman and one assistant is usually in charge of sixty or seventy-five men. It takes some time to get the gang organized, and after organization has once been effected it takes the most alert foreman to see that the work is done thoroughly. Here is where extra gang work is inefficient, in that so many laborers cannot be watched closely enough to see that the work is done well, and the laborers become aware of it and many of them (I might say one-half) are ready to take advantage of it and slight the work. To counteract this we usually select our best tampers to tamp every other tie and have the poorer ones to follow up and tamp up in full, this being the best way to handle a large crew of men. The good tampers soon learn that they are being followed by poor work and are also likely to lose interest and consequently all the work will be inefficient.

This work will hold up for a short time, anyway until the extra gang gets off of one section, the foreman believing he has done a good job, but it soon begins to fail and the section in a short time is almost as rough as before. This necessitates the regular section crew being increased three or four men, but so much money has already been expended on the division for maintenance, that it is only a short time until forces will have to be reduced in order to keep net profits up to standard.

Therefore I would be in favor of keeping regular section crews large enough to handle all regular maintenance work. A regular section crew of 7 or 8 men will do more work accordingly than a larger gang, and a better class of work can be obtained because it can be watched more closely.

I would not favor combining section crews for renewal work in relaying steel, with the exception of small jobs. Men who follow section work, as a rule do not take as much interest when taken from their regular duties. If section crews are reduced as a result of relaying, those who care for this kind of work will seek it if they can secure a place. I think that relaying should be under one good, competent foreman and assistant on a roadmaster's division, as not all section foremen would make good men to relay steel. It is important, in relaying steel, to have accurate gauge, and correct expansion under different rail temperatures and a great many foremen would not give these the proper consideration, many of them having little experience with this kind of work.

My first topic will show that extra gang work is not as efficient as regular section crews in maintenance work, but I believe extra gang work is more efficient in relaying, etc., than the combination of section crews, in that the work is more easily inspected by the foreman and consequently the men do better work.

The number of men comprising a regular section crew should be governed by amount and kind of traffic, general weather conditions, road bed, kind of ballast, etc. Under heavy traffic we should have seven or eight men eight months out of the year, and not less than three men the remaining four months, these being the winter months. With this allowance, any competent foreman should keep his section in good riding condition, cuts ditched, right-of-way clean, in fact, his entire section in first class condition.

I believe the practice of limiting expenditures in the maintenance of way department in slack seasons to be detrimental, as this is the very time that section crews can work to a great advantage on account of not being interfered with so much by traffic. Long stretches of rough track and sags can be pulled up without having to make the great number of run-offs for trains. Run-offs double the work and the fewer the section crew has to make the more expeditious the work. In my opinion it would be a great saving to railroad companies to put men enough on sections during slack seasons to put track in good riding condition, and if forces are reduced at all let it be done when business "picks up," as a small crew can look after the little jobs better than a large one.

I have found extra gang work on sections to be faulty and uneconomical, as a rule, where this method has been used to repair run down sections. Too many irregularities are left by extra gang foremen for the section foreman to look after. For example, there will be a low rail here and there show up behind them, some poor line, bad gauge, loose bolts, water ways blocked, etc. The extra gang foreman says, "We'll leave that for the section foreman, he has nothing to do." This would be well enough if the section foreman was going to be allowed a number of men, but the company thinks the extra gang foreman is attending to most all the repairing and the section crew will be reduced to one or perhaps two men, who have

so much left to them by the liberal extra gang foreman that they are again overburdened and cannot head off their work, and the track soon goes to pieces. A few low rails, spots out of line, and loose bolts soon knock out the good work the extra gang foreman has done, and the expenditure is almost a total loss.

In case of run down sections, I would favor increasing the regular section crew and if the section foreman does not make headway with improvement under favorable weather conditions, there is something wrong with him. He is either overburdened with other duties, lazy, or incompetent.

It is difficult enough in either case to obtain and hold labor for extra gangs and section forces. The section has the advantage in this part of the country, as we can get some local help except through June and July—harvest months. Extra gangs have to depend almost entirely on foreign labor. Where railroad companies furnish bunk houses of some kind for regular section crews, it is not difficult to keep foreign labor after it has been obtained.

As to reballasting, I would prefer the extra gang, again, under good, competent foremen where ballast districts are to be renewed. Here, again, we would find the majority of section foremen in the wrong place. This work should be uniform as to standards from start to finish, and could not be satisfactorily done by too many foremen. Two good extra gangs would be better, work being inspected by roadmaster frequently.

Extra gang foremen are obtained in various ways, two of the best being: First, from good assistant foremen and secondly, from the most competent section foremen, the latter generally making the best foremen.

Since I would prefer extra gang work for relaying and reballasting, as it necessitates a larger gang, and as a rule section foremen are not capable of handling large gangs, would leave this to the most competent section foremen, or regular extra gang foreman, if there be one. There are nearly always good section foremen on a roadmaster's division that could be selected for either purpose.

Personals

Although we are publishing monthly in these columns a practically complete report of all appointments of interest to our readers, it is probable that this information could be published earlier if each subscriber would make it his business to notify us of new appointments immediately. We request and we shall appreciate your assistance in this respect.

C. E. Butcher has been appointed roadmaster of the *Atchison, Topeka & Santa Fe Ry.* at Trinidad, Colo., succeeding Jacob Haas. J. A. Rohrer has been appointed roadmaster at Dalies, N. M., succeeding H. D. Young.

S. M. Beasly has been appointed roadmaster of the A. & Y. division of the *Atlantic Coast Line R. R.*, office at Fayetteville, N. C. C. B. Riddick, formerly roadmaster at Wilmington, has been appointed roadmaster at Tarboro, N. C., succeeding J. E. Hines, who held the position as relieving or extra roadmaster. J. M. Tuten, formerly acting roadmaster at Leesburg, has been appointed roadmaster at Waycross, Ga.

M. D. Carothers has been appointed supervisor of the *Baltimore & Ohio Southwestern R. R.* at North Vernon, Ind., succeeding R. W. Gabriel, promoted.

W. H. Robinson has been appointed roadmaster of the *Bay of Quinte Ry.*, office at Desoronto, Ont.

J. P. Anderson has been appointed roadmaster of the Saskatchewan division of the *Canadian Pacific Ry.* at Saskatoon, Sask., succeeding J. Canty. F. Belkia has been appointed roadmaster of the Eastern division at Ottawa, Ont. L. Berger has been appointed roadmaster of the Atlantic division at Brownsville Jct., Me., succeeding F. Harris. A. Cloutier has been appointed roadmaster of the Atlantic division at Aroostook Jct., N. B., succeeding Wm. Hacking. G. Duff has been appointed roadmaster of the Eastern division at Montreal, Que. J. Evans has been appointed roadmaster of the Alberta division at Calgary, Alb., succeeding G. Peck, transferred. J. Jelly, roadmaster, has been transferred to Ottawa, Ont. M. Long has been appointed roadmaster of the Ontario division at Kingston, Ont. N. McLaughlin, roadmaster of the Eastern division, has been transferred from Sherbrooke to Farnham, Que. G. W. Peck, roadmaster of the Alberta division, has been transferred from Calgary to MacLeod, Alb. O. Sandquist has been appointed roadmaster of the Saskatchewan division at Moose Jaw, Sask., succeeding O. Koeneman. E. Walker has been appointed roadmaster of the British Columbia division at Field, B. C. J. Walsh has been appointed roadmaster of the Eastern division at Farnham, Que.

J. J. Main, formerly roadmaster of the *Central of Georgia Ry.* at Albany, Ga., has been appointed roadmaster at Union Springs, Ala. J. B. Mainor, formerly roadmaster at Eufala, Ga., has been appointed roadmaster at Cuthbert, Ga., succeeding C. F. Hayes. E. M. Waters has been appointed supervisor at Albany, Ga., succeeding Mr. Mainor.

L. B. Baker, supervisor of track of the *Chesapeake & Ohio Ry.*, has been transferred from Ronceverte to Cabin Creek Jct., W. Va.

W. H. PURCELL, Supervisor Illinois Central R. R.

G. B. Walters has been appointed supervisor of track of the *Cleveland, Cincinnati, Chicago & St. Louis Ry.* at Terre Haute, Ind., succeeding H. McClain.

E. C. Carter roadmaster of the *Denver & Rio Grande R. R.*, has been transferred from Helper to Thistle, Utah. L. P. Ogg, roadmaster of the Marysvale Branch, has been transferred from Thistle to Manti, Utah, a more centrally located office.

H. La Boursadiere, formerly supervisor of track of the *Grand Trunk Ry.* at St. Charles, has been appointed supervisor at Montreal, Que.

Fred Becker has been appointed assistant roadmaster of the *Great Northern Ry.* at Leavenworth, Wash., succeeding Ed Kelly. Frank Cleary has been appointed assistant roadmaster at Kelly Lake, Minn., succeeding Joe Stralka. C. Holm has been appointed assistant roadmaster at Everett, Wash. J. R. McGarvey has been appointed assistant roadmaster at Great Falls, Mont., succeeding J. Wallin.

W. H. Purcell, who has been appointed supervisor of the *Illinois Central R. R.* at Fulton, Ky., began work with this company as section laborer in 1895, and has held successively the positions of assistant foreman, section foreman and extra gang fore-

man till Sept. 1, 1913, the date of his appointment as supervisor.

C. W. Archibald has been appointed roadmaster of the *Intercolonial Ry.* at Truro, N. S., succeeding J. C. Fulmore, appointed roadmaster at Sydney, C. B. A. E. Wellwood has been appointed roadmaster at New Glasgow, N. S., succeeding A. B. Gray, superannuated. Mr. Wellwood entered the service of the Intercolonial as track man in 1882. He was appointed extra gang foreman in 1890, and inspector of capital account work in 1890, the present appointment taking effect Sept. 1, 1913.

F. W. Hanley has been appointed roadmaster of the *International Rys. of Central America* at Ste. Lucia, Guat., C. A. J. D. Roberts has been appointed roadmaster at Guatemala, Guat., C. A. H. R. Wheeler has been appointed roadmaster at Escuintla, Guat., succeeding A. G. Wilkes.

M. Mace, formerly supervisor of track of the *Kanawha & Michigan Ry.* at Charlestown, W. Va., has been appointed supervisor at Middleport. O. C. Williams, supervisor, has been transferred from Hobson to Charleston, W. Va.

R. D. Watkins has been appointed supervisor of the *Louisville & Nashville R. R.* at Erin, Tenn., succeeding J. Redmond.

J. Crooks, roadmaster of the *Minneapolis, St. Paul & Sault Ste. Marie Ry.*, has been transferred from Moose Lake to Superior, Wis. Since Aug. 1 Mr. Crooks has had charge of both the First and Second districts. He retains charge of the First district, and J. R. Michaels has been appointed acting roadmaster of the Second district, office at Moose Lake, Wis. He succeeds J. Jaglo, who has been appointed roadmaster at Devils Lake, N. D.

The general offices of the *Missouri & North Arkansas R. R.* have been moved, and P. Hanson, division roadmaster, is now located at Harrison, Ark.

W. A. Battle has been appointed roadmaster of the *Missouri, Kansas & Texas Ry.* at Wichita Falls, Tex. E. E. Hanna has been appointed roadmaster at Smithville, Tex. P. Sweeney has been appointed roadmaster at Waco, Tex.

J. H. Pruitt, roadmaster of the *Missouri, Kansas & Texas Ry. of Texas*, has been transferred from Granger to Smithville, Tex.

R. C. White has been appointed general roadmaster of the *Missouri Pacific Ry.* at Wynne, Ark., succeeding W. A. Kennon. The headquarters of C. A. Nealis, roadmaster, have been moved from Lake Village to McGehee, Ark., following a change in Mr. Neallis' and J. A. Morris' territories. Mr. Morris' address is unchanged at Dermott, Ark. I. D. Roam has been appointed roadmaster at Russellville, Ark., succeeding J. Y. Dollar, appointed roadmaster at Beebe, Ark. G. W. Tull has been appointed roadmaster at Coffeyville, Kan., succeeding F. M. Fry.

W. J. Calvin has been appointed roadmaster of the *Northern Pacific Ry.* at Sedro Wooley, Wash., succeeding W. H. Gale. I. M. Taylor is acting roadmaster at Forsythe, Mont., in place of Gustav Gullickson, on leave of absence.

E. C. Buhrer, formerly at Pendleton, has been appointed roadmaster of the *Oregon-Washington R. R. & Navigation Co.* at La Grande, Wash. T. Keavney has been appointed roadmaster at Colfax, Wash.

P. J. Adams, roadmaster of the *San Pedro, Los Angeles & Salt Lake R. R.*, has been transferred from Provo to Milford, Utah. Charles Moore, formerly roadmaster at Caliente, has been appointed roadmaster at Provo, Utah, succeeding Mr. Adams.

B. O. Thistle has been appointed roadmaster of the *Southern Pacific Co.* at Sacramento, Cal., succeeding P. T. Robinson.

Thos. Burke, formerly roadmaster, has been appointed division roadmaster of the *Texas & Pacific Ry.* at Texarkana, Tex. Gus Crawford has been appointed roadmaster at Baird, Tex., succeeding T. J. Hunt. Additional territory has been assigned to W. G. Kelley, roadmaster, and his office moved from So. Mansfield to Sodus, La. J. P. Manning has been appointed roadmaster at Shreveport, La. B. E. Mosher has been appointed roadmaster at Mineola, Tex. Additional territory has been assigned C. O. Watts, roadmaster, and his office moved from Melville to Bunkie, La.

M. Dyson has been appointed roadmaster of the *Wheeling & Lake Erie R. R.* at Norwalk, O., succeeding I. Malone, who was located at Toledo, O.

With The Manufacturers

B. & B. SUPPLY ASSOCIATION.

The Bridge and Building Supply Men's Association prepared an exhibit in the parlors adjoining the convention hall of the Bridge and Building Ass'n.

The officers of this association for the past year were: President, H. Henning, Eastern Granite Roofing Co.; first vice-president, J. A. Meaden, Paul Dickinson, Inc.; treasurer, D. A. Bonitz, National Roofing Co.; secretary, H. A. Neally, Joseph Dixon Crucible Co. At the annual meeting of the association held on Tuesday morning, the following officers were elected for the ensuing year: President, J. A. Meaden; vice-president, D. A. Bonitz; treasurer, H. A. Neally; secretary, L. D. Mitchell.

The following firms were represented:

American Hoist and Derrick Co., St. Paul, Minn.—Model of American ditcher and photographs. Representatives, F. J. Johnson and W. O. Washburn.

Asphalt Ready Roofing Co., New York.—Samples of asphalt roofing and shingles. Representatives, H. H. Husted and W. A. Hemenway.

American Track Barrow Co., The, Lowell, Mass.—Track barrows, lumber dollies and material boxes. Representative, E. B. Peirce.

American Valve and Meter Co., Cincinnati, Ohio. Representative, J. T. McGarry.

Barrett Manufacturing Co., New York.—Literature. Representatives, H. B. Nichols and G. K. Dearborn.

Buda Co., The, Chicago.—Literature and photographs of motor cars. Representative, G. A. Glasford.

Carey Company, Philip, Cincinnati, Ohio.—Samples of waterproofing and photographs. Representatives, W. F. T. Cheesman, A. Wallace and Wm. Ignatius.

Chicago Bridge and Iron Works, Chicago.—Photographs and literature. Representatives, M. J. Trees and K. I. Small.

Chicago Pneumatic Tool Co., Chicago.—Air drills and motor cars. Representatives, C. E. Walker, J. McCabe, Thos. Aldcorn and A. Allen.

Clapp's Fire Resisting Paint Co., Bridgeport, Conn.—Representative, W. A. Clapp.

Detroit Graphite Co., Detroit, Mich.—Literature. Representatives, L. D. Mitchell and Wm. Bates.

Dickinson, Paul, Inc., Chicago.—Literature and models of smoke jacks. Representatives, A. J. Filkins and J. A. Meaden.

Dixon crucible Co., Joseph, Jersey City, N. J.—Photographs and literature. Representatives, H. A. Neally and L. M. Chase.

Eastern Granite Roofing Co., New York.—Representatives, A. A. Taylor, Geo. J. Akers, J. L. Jones and F. M. Condit.

Fairbanks, Morse & Co., Chicago.—Literature. Representatives, A. A. Taylor, Geo. J. Akers, J. L. Jones and F. M. Condit.

Forest City Paint and Varnish Co., Cleveland, Ohio.—Representative, W. B. Wood.

Heath & Milligan Co., Chicago.—Representatives, W. S. Mellen and W. H. Pratt.

Johns-Manville Co., H. W., New York—Representatives, W. H. Lawrence, P. C. Jacobs, R. A. Hamaker, H. L. Leach and J. E. Meek.

Lehon Co., The, Chicago.—Samples of roofing and literature. Representative, Tom Lehon.

Mudge & Co., Burton W., Chicago.—Mudge-Adams motor car. Representatives, J. C. Donnelly and J. P. O'Reilly.

National Roofing Co., Tonawanda, N. Y.—Samples of roofing. Representatives, D. A. Bonitz and C. A. Sullivan.

Patterson Co., W. W., Pittsburgh, Pa.—Representative, W. W. Patterson, Jr.

Pedlar People, Limited, The, Oshawa, Ont.—Sample Toncan metal corrugated culvert. Representatives, A. T. Enlon and W. E. Ramsay.

Railway Engineering and Maintenance of Way. Representative, K. L. Van Auken.

Richards-Wilcox Manufacturing Co., Aurora, Ill., and London, Ont.—Door hardware. Representative, W. D. Jameson.

Standard Asphalt and Rubber Co., Chicago.—Photographs and samples of waterproofing. Representatives, I. B. Patterson and C. V. Eades.

The Railway List Co.—Copies of "The Monthly Official Railway List," "The Weekly Official News Bulletin," and "Railway Engineering."

Templeton, Kenly & Co., Chicago.—Simplex jacks. Representatives, Alfred E. Barron and Arthur C. Lewis.

Texas Co., The, Houston, Tex.—Representatives, W. E. O'Neill and W. E. Greenwood.

U. S. Wind Engine and Pump Co., Batavia, Ill.—Literature. Representative, C. E. Ward.

Wadsworth-Howland Co., Chicago.—Representative, E. E. Allen.

Webb Manufacturing Co., F. W., Boston, Mass.—Samples of unions. Representative, Geo. H. Ayer.

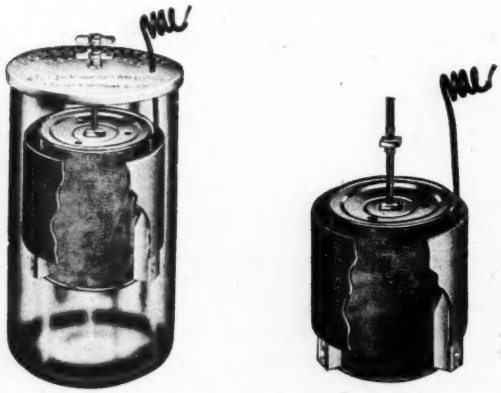
IMPROVED TYPE OF PRIMARY BATTERY CELL.

Recent notable developments in primary batteries are noted in the new type Gordon R. S. A. cell.

Improvements over the old type of Gordon cell are in the arrangement of the elements, which are higher in the new cell, and are located at the center of the solution. In order to get the necessary areas, the diameter of the elements has been substantially increased. This provides greater zinc and depolarizing surfaces which provide for the increased capacity for heavy discharge.

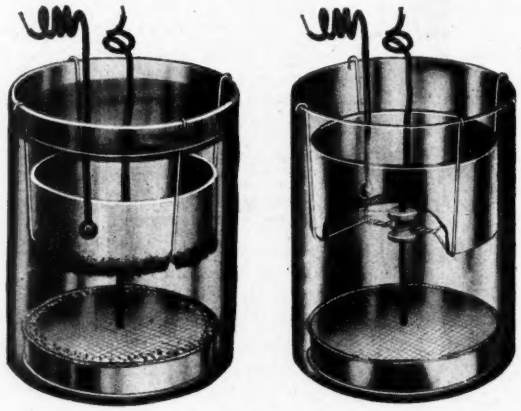
The copper oxide in this, as in the former Gordon cell, is in flake form, giving a maximum surface exposed to the action of the solution. As the number of amperes of electricity which may be taken from a cell depends on the amount of material decomposed, the importance of the flake copper oxide is apparent.

In this new type the entire element is submerged and is supported by a conducting rod projecting through the cover and threaded to meet the R. S. A. specifications. This conducting rod passes entirely through the copper oxide element and is securely fastened to both top and bottom thereby making most positive contact. There is no possibility of nuts making this contact becoming loose as this is guarded against by offsets at these points.



Gordon Primary Battery Cell.

The highest quality of materials is used in these cells, and the new treatment of these materials enables the cell to give longer life. The capacity for delivering current at three amperes discharge is greatly in excess of the specifications of the Railway Signal Association.



Waterbury Track Cell.

The claims made by the manufacturer are that the new type Gordon cell will maintain voltage under heavy current discharge longer and more uniformly than any other primary cell.

Realizing the demand for a caustic soda battery for track circuit work, the Waterbury track cell has also been developed by the Gordon Battery Co.

This track circuit cell embodies unique features such as provision for equidistance of elements at all times. This equidistance of elements provides for uniform internal resistance and consequently uniform action until the cell is exhausted.

Other features are extreme simplicity of construction and ease of setting up and recharging. All these features are readily apparent in the illustrations shown herewith.

PEERLESS FAULT FINDER.

We illustrate herewith the Peerless Fault Finder, an electrical measuring instrument for use in following up trouble with electric currents. This instrument is the only one on the market which allows the tester to make the Murray Loop Test and the Varley Loop Test, by operating only one switch. This specially designed switch was developed in the laboratories of the Thompson Levering Co., of Philadelphia, the manufacturers of Peerless electrical measuring instruments. The Fault Finder is of such construction that it is merely necessary to have the indicators pointing to the test desired, when the connections underneath are arranged for the above mentioned tests.

The manufacturers state that the materials used in the construction of the T-2062 fault finder, illustrated herewith, are the best obtainable throughout, and that no expense has been spared to obtain a high-grade standard of excellence, which denotes a superior product. The mounting plate is pure, high-grade, hard rubber.

Metal parts are of solid brass, gold lacquered, after being perfectly polished and grained. Binding posts are all of the double grip type, which enables one to clamp any size wire, from the finest to the largest used in ordinary testing work.

The case is of solid oak, protected by heavy nickel-plated brass corner clips, with lock and key and leather carrying handle, and rubber feet on the bottom of the set where it is

Peerless Fault Finder.

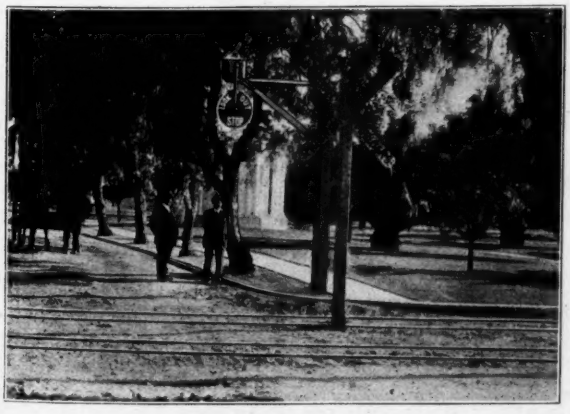
placed when not in use, and also on the back of the set, so that any one may lay it down in any normal position and still be protected.

Full directions for each test are given on the card of directions, and inserted in the lid of the instrument. There is a piece of transparent celluloid placed over these directions, so that they are kept clean and legible, making them good for years.

THE WIG-WAG CROSSING SIGNAL.

The illustration herewith represents a heretofore dangerous grade crossing on the Pacific Electric Company's lines within the city limits of Los Angeles. This crossing which is now protected by the Automatic (Wig-Wag) Flagman is used by funeral corteges on their way to Rosedale Cemetery, and is considered the worst on the lines of the above company, which has in service several hundred of these signals at various points on its line.

Both steam and electric lines using "Wig-Wags" have found it economical to buy electric current from municipalities and operate all within the boundaries of one city, or at least all in one vicinity, from one meter, and this method furnishes protection for grade crossings at a cost that is almost nominal for each crossing. Fortunately for the railroads, this signal is readily accepted by the municipal authorities in most cases, in the place of gates or crossing flagmen. The city of Los Angeles, through its Public Utilities Board, recently ordered 108 grade crossings protected and, of its own accord, recommended the "Wig-Wag" as the proper protection at 71 out of the 108. In these days of agitation for grade crossing protection and elimination of grade crossings, the advent of this signal gives the railroad an opportunity to avoid a large maintenance expense in the shape of wages of crossing flagmen and gatemen.



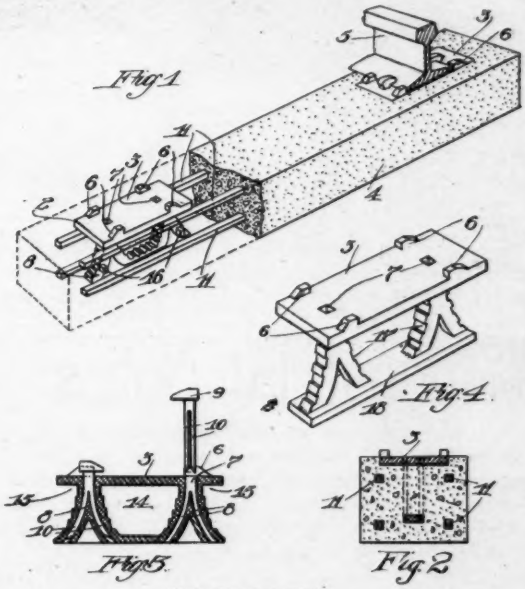
Wig Wag Crossing Signal.

Any railway man interested in grade crossing protection will be interested in a demonstration of the Wig-Wag signal, at the Permanent Railway Exhibit, Karpen Bldg., Chicago. This exhibit is in charge of M. J. Egleston, Chicago representative of the Automatic Flagman Co., of Los Angeles, which is marketing the crossing signal described herein.

THE SISK CONCRETE TIE.

The illustration herewith shows a concrete tie of considerable merit. The tie is manufactured by the Sisk Universal Concrete Railroad Tie Co., Nevada National Bank Building, San Francisco; the tie, however, can be made on the job by arrangement with above mentioned concern, which will in that case, furnish the necessary rail seats and spikes.

By reference to the drawing, it will be noted that the rail holding device is of peculiarly substantial nature. The spike



Sisk Concrete Ties.

is split and, in driving, follows the channels in the rail seat and when fully driven a holding power of about 11,000 is obtained; this being the resistance offered in withdrawals. It is said that the holding of an ordinary drive spike averages about 4,000 lbs. The rail chairs are of malleable iron and are so designed as to obtain a large bearing surface on the concrete. The rail seat furnishes a large bearing surface which prevents contact between rail and concrete and lugs which are integral with the seat locate the rail laterally with absolute accuracy, thus preventing the possibility of spreading. In this way lateral pressure upon the spikes is entirely eliminated.

The Sisk tie is being used in the West with success. The cost of handling the concrete tie is, of course, less than is the case with either steel or wood because the ties are constructed on the division. The upward trend in the prices on wooden ties has already reached a point where engineers are being pressed to secure practical and efficient substitutes. It is believed that the Sisk tie is now beyond the experimental stage.

STANDARD SAFETY SIGN.

Recent public attention is being focused on the subject of saftey, and the popularity of the movement and the attention given it by the railways shows its importance.

The suggestion has been made that a standardized "safety first" emblem would tend to increase the effectiveness of this movement.

The idea of standardization is admitted to be an excellent

Safety First Emblem.

one and one which has saved a great deal of money, provided standardization does not retard development. Such cases might occur in designs of engineering construction, but standardization of different signs could not be objectionable.

The safety first sign illustrated here was designed and is controlled by the Stonehouse Enameled Steel Sign Co., Denver, Colo.

Industrial Notes

Combination of Sales Organizations.

Hydro-Products is the name covering a line of waterproofing compounds, cements and floor materials the sale of which has been taken over by Mr. J. L. Phillips, of the Carbo-Lundum Cement Hardener Co., 900 So. Michigan avenue, Chicago.

Carbo-Lundum will be sold under the same name and in the same manner as usual; it is a cement hardener with pure carborundum and alundum in its composition.

Hydro-Corundum is a mixture of Hydrolithic Portland cement and Carbo-Lundum, already mixed and ready to lay for making cement floors durable.

Hydro-Lithic waterproof cement is the original Hydrolithic cement used for years for waterproofing battery vaults, tunnels, buildings and fortifications.

Hydro-Concentrates is an integral waterproof cement compound that is mixed with the cement in foundation work.

The materials will be handled through Mr. Phillips at the above address and branches in the large cities of the country from coast to coast.

The railway business will be handled by M. J. Eggelston, Karpen building, Chicago, W. S. Hall, West building, 90 West street, New York, and by the Waterproofing Co., 412 Navarre building, St. Louis, Mo.

The Lehigh Valley has recently sold to the H. W. Pickett Co., Philadelphia, Pa., about 230,000 feet of No. 1 relaying rail, varying in weight from 56 to 67 pounds.

The U. S. Light & Heating Co. announces the removal of its New England Sales Office, formerly located at 84 State street, to 25 Irvington street, Boston, Mass. The change brings the New England U-S-L service station and sales office under one roof, an arrangement which it was deemed advisable to make because of increase in business and because of the greater opportunity afforded for close cooperation between the two departments.

The American Metal Tie Co., Paducah, Ky., has been incorporated with a capital stock of $500,000 to manufacture a railroad specialty. C. E. Stavely and L. B. Langston are the incorporators.

The Conley Frog & Switch Company, of Memphis, Tenn., has started work on an addition to its plant, 40 ft. x 100 ft., which will be used as an erecting shop.

C. C. Dhittier has been made treasurer and general manager of Robert W. Hunt & Co., Ltd., with headquarters at 905 McGill building, Montreal, Que. T. C. Irving, Jr., has been re-elected vice-president of the company and will remain in charge of the business in Toronto and the surrounding district.

Pressure of business requiring his immediate attention in England and on the Continent caused Mr. J. Allen Smith, president of the U. S. Light & Heating Co., to start on his second transatlantic trip of the year on the 11th of October. Mr. Smith will not only attend to unfinished and new business, but will endeavor to visit the various automobile shows, which are held earlier in England and Europe than in this country.

A. F. Young, formerly manager of the railway sales department of the International Harvester Company of America, has been appointed railway sales agent for that company, with offices at 1200 Karpen building, Chicago. In addition to the Harvester

A. F. YOUNG, President
A. F. Young Railway Supply Co.

company's line of oil and gasoline engines and pumps, Mr. Young is handling the sale of the Wisconsin Steel Company's product of steel castings, etc., together with a reliable line of track tools, track shovels, locomotive scoops, power pumps, steam pumps, steam engines and boilers, etc. Mr. Young has numerous railroad friends and a wide acquaintance with the railroad trade, which, together with his thorough knowledge of the business, assures the success of the A. F. Young Railway Supply Co., under which firm name the new company is operating.

The Galena Signal Oil Co., it is reported, has purchased property at Clearing, Ill., on which it will erect a concrete and brick warehouse, power plant and steel storage tanks at a cost of $50,000.

The High-Brows Of The Shop

will tell you that the word WRENCH comes from an old Anglo-Saxon word, WRINGAN, which meant WRING; that it appears in Middle High German as RENKEN, which meant to bend or turn, and that it appears in Modern German as VERRENKEN—to sprain or wrench—the present meaning of the word.

But we say to you that the word wrench means little without the prefix-COES

This prefix has injected more meaning into the word than all its past history.

A COES WRENCH is a happy combination of good design, good material, and good workmanship that dignifies and lightens labor everywhere;

And the high-brows of the shop will tell you so.

COES WRENCH CO.
WORCESTER, MASS.

CALUMET SUPPLY MFG. CO.
MANUFACTURERS OF
CALUMET
STEEL CATTLE GUARDS
STEEL FENCE POSTS
WING FENCE APRONS
WE SPECIALIZE IN MAINTENANCE OF WAY EQUIPMENT
OFFICE 1213 KARPEN BLDG. CHICAGO WORKS HARVEY, ILL.
WRITE FOR PRICES AND 1913 CATALOGUE

BROADWAY CENTRAL HOTEL

Broadway, corner Third Street

IN THE HEART OF NEW YORK

Only Medium Price Hotel left in New York

SPECIAL ATTENTION GIVEN TO LADIES UNESCORTED

SPECIAL RATES FOR SUMMER

OUR TABLE is the foundation of our enormous business

American Plan, $2.50 Upwards

European Plan, $1.00 Upwards

Send for Large Colored Map of New York, FREE

DAN C. WEBB, Proprietor

The ONLY NEW YORK HOTEL FEATURING AMERICAN PLAN

Moderate Prices. Excellent Food. Good Service.

A Concrete Tie

with a simple and practical rail fastener which has

Made Good

An investigation of the merits of this tie will mean business for us and satisfaction for the purchaser

FOR FULL PARTICULARS WRITE

Sisk Universal Concrete Railroad Tie Co.

Nevada National Bank Building

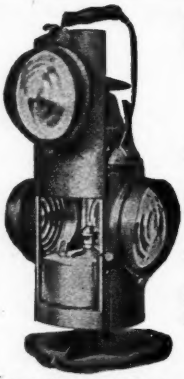
San Francisco California

In the last issue of this publication there appeared a statement in the above advertisement which read:

"*We furnish Mold and Spikes*"

this was an error and should have read:

"*We furnish Rail Seats and Spikes.*"



Round Body Steel Switch Lantern

LANTERNS

SWITCH, ENGINE, SIGNAL, SEMAPHORE, MARKER, STATION, Etc.

CHIMNEYLESS BURNERS

for one day and long-burning service

30 YEARS' EXPERIENCE

New and specially equipped factory enables us to fill large orders promptly and at fair prices.

Illustrated catalogues on request.

PETER GRAY & SONS, Inc.

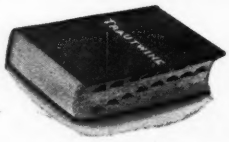
Mail Address: "Cambridge", BOSTON, MASS.

Chicago Office: 303 Great Northern Bldg.

JOSEPH M. BROWN, Representative.

TRAUTWINE

THE CIVIL ENGINEER'S POCKET-BOOK



120th Thousand, 1913.

Third Issue of the 19th Edition.

1300 Pages. Illustrated.

Morocco, 16mo.

Gilt Edges.

Thum-Indext, $5.00 net.

1913 Issue Now Ready

The 1911 issue being exhausted, we take advantage of the fact by correcting, in the 1913 issue, such errors as have been discovered in its predecessor.

Thum-indext without extra charge

Of the 1911 issue we offered thum-indext copies at an advance of 25 cents each. This experiment having given satisfaction to our readers, we are thum-indexing the 1913 issue, and we now offer this added feature without extra charge.

In other words, the price is now

$5.00 net, thum-indext

TRAUTWINE COMPANY, Philadelphia, Pa.

Shipping Dept. 257 South 4th Street.

EDISON-BSCO
Type 452 Cell, 450 Ampere Hours Capacity.

EDISON BSCO PRIMARY BATTERY

The Standard Closed Circuit Cell

Maintaining the voltage of a track circuit at the lowest point compatible with good relay action not only makes for economy, but increases the reliability of the circuit.

A track circuit, to be clean cut in operation but sensitive, should include a current source permitting the regulation at the battery end to avoid putting on the rails a higher e. m. f. than the relay requires. When the voltage is higher than necessary the waste through low resistance ties or ballast is heavy; there exists a possibility of the relay remaining closed, should a break in the rail circuit occur, and the action of the relay is not improved by the surplus energy flowing through the coils.

The resistance of the rails (80¾ to the yard) in a mile track circuit is approximately .148 ohms, which may be trebled by the resistance of the joints and will be considered .444 ohms. The current flow in the average circuit is, on account of leakage, heavier at the battery end than near the relay, but assuming an average flow of .15 amperes, the voltage drop due to rail resistance is .067 volts.

A set of EDISON-BSCO cells with suitable resistance connected in series will, under the conditions outlined, deliver .483 volts at the relay, this being sufficient to force .121 ampere through a 4 ohm coil. The ability of the cells to discharge at comparatively high rates with little effect on the voltage tends to eliminate the danger of failure during wet weather; the constant voltage maintained from beginning to end of life is in strong contrast with the lack of uniformity characteristic of gravity cells; the economy effected in both materials and labor, and the long life by which renewal in unseasonable weather is avoided, makes the proposition attractive from every standpoint.

Catalog, or Estimates on Request

The cheapest form of battery energy

TRADE MARK
Thomas A Edison

Thomas A. Edison, Inc.

284 Lakeside Ave. Orange, N. J.

EDISON-BSCO
Complete Renewal.

Cook's Magic Tool Grinder

It is geared high. The gears are all enclosed, and are kept free from dirt. The patented holder makes it possible for any laborer to correctly sharpen a drill bit; simply place the bit in the holder and swing to and fro against the wheel. The holder can be adjusted to give any clearance to the bit point.

Complete description in our catalogue—Write for it.

NATIONAL STANDARD CO., NILES, MICH. U. S. A.

M. C. B. Co., McCormick Bldg., Chicago — Western Agents

H. M. BUCK, 30 Church St., N. Y. — Eastern Agents

THE JOHNSON CAR REPLACER

Range and capacities of the different types are as follows:

		If Not Over	Capacity.	Throat Opening.	Wt. Each.
Type M for rail 12 - 45 lbs.		3½ Inches high	20 Ton Locomotive	2 Ins.	30
Type C for rail up to 65 lbs.		4½ Inches high	30 Ton Locomotive	2½ Ins.	60
Type B for rail up to 80 lbs.		5 Inches high	50 Ton Locomotive	3¼ Ins.	110
Type A for rail up to 100 lbs.		5½ Inches high	80 Ton Locomotive	3½ Ins.	145
Type Z for rail up to 100 lbs.		6 Inches high	100 Ton Locomotive	3½ Ins.	165

THE JOHNSON WRECKING FROG COMPANY, CLEVELAND, OHIO

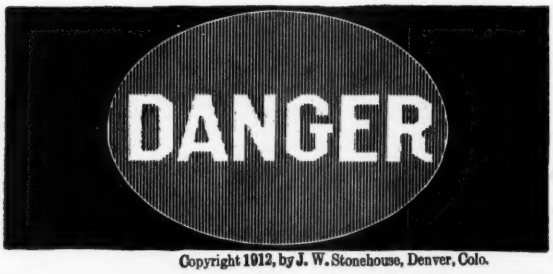
ENGINEERS AND CONTRACTORS

STRUCTURES
ENGINE HOUSES, FREIGHT HOUSES, POWER PLANTS. STACKS, FOUNDATIONS, ETC.

EQUIPMENT
STEAM, AIR, WATER AND ELECTRIC EQUIPMENTS, HEATING: BOILER WASHOUT AND FILLING PLANTS; HEAVY PIPE WORK

GALE INSTALLATION COMPANY, McCormick Building, CHICAGO

THERE IS NO



Copyright 1912, by J. W. Stonehouse, Denver, Colo.

Of Mistaking the Meaning of This Sign

The word DANGER appears in white on a brilliant red oval set on a black background.

The color combination is striking—it immediately conveys a warning, and its brilliancy and sharp contrasts compel attention.

It is cheaper to install this sign than to install a wooden one; in fact it's cheaper to install a new **Universal** sign than to pay for maintaining an old wooden one. **Universal** signs will not chip, crack, rot or fade, and they are so well protected by the enamel that they will practically never rust. The colors and letters are **burned on,** and they will **stay on.** Weather and smoke does not dim the brilliancy of these signs.

Our manufacturing facilities enable us to make these signs in quantities and allow us to quote surprisingly low prices. These three considerations—the brilliancy and sharp contrasts which compel attention—the durability —and the low price—have set in motion a campaign to make the Universal the **Standard** danger sign. We will be glad to send you, without charge, a full sized print of the Universal in colors, and furnish prices.

We can also quote some very attractive figures on special enameled signs and notices for platforms, crossings, culverts, bridges, waterways, cattle passes, third rails, slow speed sections, whistle posts, yard limits and siding.

Let us figure on your requirements.

The Stonehouse Enameled Steel Sign Company

CLAYTON BLOCK :: :: :: DENVER, COLO.

The FRANKLIN
ASBESTOS SMOKE JACK

Support on Top of Roof

ASBESTOS RAILWAY SUPPLIES, EVERY DESCRIPTION

ASBESTOS "CENTURY" SHINGLES

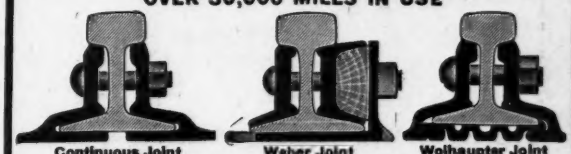
CORRUGATED SHEATHING

ASBESTOS FLAT LUMBER

Requires no paint. No rust. Everlasting and fireproof.

Franklin Manufacturing Co., Franklin, PENNA.

OVER 50,000 MILES IN USE



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ROLLED FROM BEST QUALITY STEEL

The Rail Joint Co. General Offices: 185 MADISON AVENUE, NEW YORK CITY

Makers of Base-Supported Rail Joints for Standard and Special Rail Sections, also Girder, Step or Compromise, Frog and Switch, and Insulated Rail Joints, protected by Patents.

CATALOG AT AGENCIES

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WE WILL HELP YOU STAND THE

HARD BUMPS

One Million One Hundred Thousand Foot Pounds Shock Without Camage to Cars or Posts

Hercules Steel Bumping Post Heavy Freight Type No. I

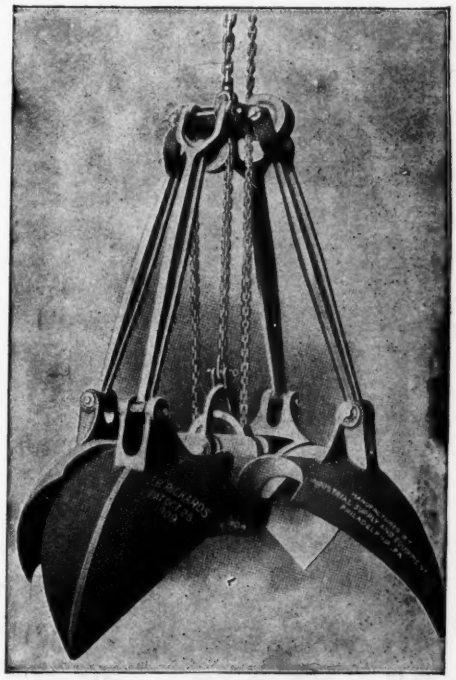
NOW IN USE ON

Penna.—L. S. & M. S.—C. & N. W.—Panama Canal—Southern—C., M. & St. P.—C. R. R. of N. J.—Ill. Northern—D. & H.—Hock. Valley—Seaboard A. L.—L. & N.—Brooklyn Rapid Transit—Northwestern Elevated—Georgia R. R.—Southern Pacific—A., T. & S. F.—C., St. P., M. & O., and many others.

WHY NOT ON YOURS?

Railway & Traction Supply Co., RECTOR BUILDING, CHICAGO

Sole Manufacturers—Hercules Steel Bumping Post for Passenger, Freight or Elevated Service
Wyoming Vacuum Track Sander
Wyoming Automatic Curtain Release



THE BUCKET
And What the Owner Says

"The first thirty days we operated your three yard bucket we received an excess check of $2,700."

If you are any judge at all, look at above and look at the design of our

All Cast Steel Orange Peel Bucket

The Best on the Market. Costs No More

WRITE US

The Industrial Supply & Equipment Co.

407 Sansom Street, Philadelphia, Pa.

Agents— J. E. CHISHOLM, 350-55 Old Colony Building, Chicago
FRANK D. MOFFAT & CO., New York and Boston

Our guarantee, "more yards per day under like conditions than with any other bucket."

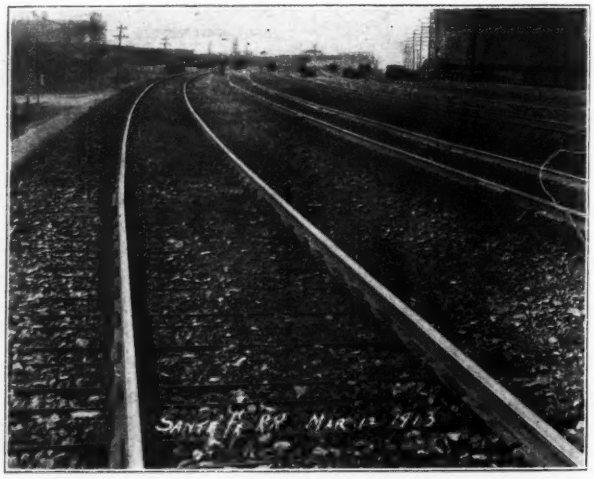
Universal Metallic Ties

have overcome the last remaining objection urged against steel ties, viz.:

The Excessive Rigidity, Resulting in Absence of Sufficient Wave Motion or Elasticity

THIS IS TAKEN CARE OF BY A WOODEN BLOCK SUPPORT

The total elimination of spikes, angle bars, rail anchors and brace chairs, and of the necessity for their continued replacement, together with their high scrap value after long service, makes the "Universal Tie" superior in every point of cost and service to the wooden tie, with its rapidly increasing cost, decreasing quality and inflammable character, made more so by creosote treatment, and makes possible a



SECTION OF TRACK EQUIPPED WITH UNIVERSAL METALLIC TIES ON A., T. & S. F. RY. AT 22nd ST., CHICAGO

Safe and Permanent Roadway

Now Installed on Main Lines of

Pennsylvania Railroad — New York Central
Pittsburgh & Lake Erie — A., T. & S. F. Ry.
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Write for Catalogue and Further Details

Universal Metallic Tie Co.

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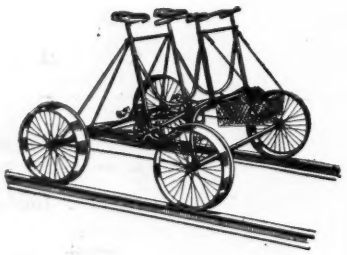

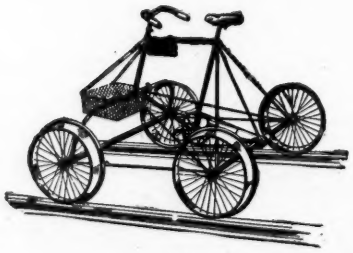

Light Inspection Cars are the Strongest and Lightest running known. The fact that we constantly receive repeat orders is proof absolutely that our cars are giving entire satisfaction. We shall be pleased to supply you with our new catalog that tells all about them.

LIGHT INSPECTION CAR CO.

HAGERSTOWN, INDIANA

"Ticonderoga," said Old Jerry, "is where our boys did some great scrappin' and that's the place where Dixon's Flake Graphite comes from.

"Speakin' of fightin'," continued Jerry, "Flake graphite has licked the stuffin' out of old General Friction so many times that its got all right thinkin' engineers rootin' for it like a bunch of fans at a baseball game.

"I used to wonder how I got along without Dixon's Flake Graphite but we didn't used to have any superheaters until I got to runnin' Old 689 and broke all records on the road. It was a lucky day for Jerry when I came across that old Dixon ad and wrote for the booklet and sample No. 104. They're still advertisin' 'em."

Joseph Dixon Crucible Co.

Established 1827

Jersey City :: N. J.

41-C

ELLIS PATENT BUMPING POST

Noted for Simplicity, Strength and Lasting Qualities. Adapted to all positions.

Mechanical Mfg. Co.,
CHICAGO. ILL.

Positions & Men Wanted

Wanted—Chief Draftsman

An established Consulting Engineering and Construction Corporation, based on co-operative plan, offices in Cleveland, Detroit, Buffalo and New York City, has a good opening for an experienced Chief Draftsman, not under thirty, to take full charge of the Drafting Department. Highest references and $1,000 stock investment required. Contract with salary, commission and interest in business guaranteed. Answer, "Chief Draftsman."

Wanted—Position

By Roadmaster who has had 26 years' experience and can give recommendations from several of the larger railways. Has been engaged in private business, but desires to return to railway work. Address E. R., care Railway Engineering, 431 S. Dearborn street, Chicago, Ill.

The Trackman's Helper

Revised Edition—by J. KINDELAN

A Practical Guide for Track Foremen

Thirtieth Thousand

"It is so very plain and easily understood, its value to men of ordinary education cannot be estimated."—D. A. Dale, Roadmaster, West Shore Ry.

"I find the Revised Trackmen's Helper the most generally instructive and useful book for trackmen that is now obtainable. I think every Track Foreman and Roadmaster should have a copy of it."—D. Sweeney, Roadmaster, C., B. I & P. Ry.

350 pages; fully illustrated, 5¼x7½ inches. Price, $1.50, net postpaid.

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By D. H. LOVELL
Division Superintendent Pennsylvania Ry.

An Instructor and Guide for Roadmasters, Section Foremen and Construction Foremen

This book is presented in a very clear manner, which is at once simple, thorough and practical.

The contents include chapters on General Turn-outs; Stub and Split Switches; Analysis of Curves; and a large number of tables for the quick and correct construction of any switch.

Cloth, 174 pages; 4½x6¼ inches. Price, $1.00, net postpaid.

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Fairmont Machine Co., Fairmont, Minn.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Thompson, J., & Sons, Mfg. Co., Beloit, Wis.

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Fairmont Machine Co., Fairmont, Minn.
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Hand Cars.
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Gale Installation Co., Chicago.

Hoes.
Hubbard & Co., Pittsburgh, Pa.

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Verona Tool Works, Pittsburgh, Pa.

I-Beam Carrying System.
Richards-Wilcox Mfg. Co., Aurora, Ill.

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Chicago Pneumatic Tool Co., Chicago.
Light Inspection Car Co., Hagerstown, Ind.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
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Insulation and Insulating Material.
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Okonite Co.

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Gray, Peter, & Sons (Inc.), Boston.

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Lightning Arresters.
United Electric Apparatus Co., Boston, Mass.

Line Material.
Electric Ry. & Equip. Co., Cincinnati, O.

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Richards-Wilcox Mfg. Co., Aurora, Ill.

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Johnson Wrecking Frog Co., Cleveland, O.

Lubricants, Graphite.
Dixon, Jos., Crucible Co., Jersey City, N. J.

Lubrication, Graphite.
Dixon, Jos., Crucible Co., Jersey City, N. J.

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Hubbard & Co., Pittsburg.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

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Cincinnati Frog & Switch Co., Cincinnati, O.
Frog, Switch & Mfg. Co., Carlisle, Pa.
Indianapolis Switch & Frog Co., Springfield, O.
Ramapo Iron Works, Hillburn, N. Y.
Weir Frog Co., Cincinnati, O.

Mast Arms.
Electric Ry. Equipment Co., Cincinnati.

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Pumps, Oil.
Bowser, S. F., & Co., Ft. Wayne, Ind.

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Positive Rail Anchor Co., Louisville, Ky.

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Cincinnati Frog & Switch Co., Cincinnati, O.
Indianapolis Switch & Frog Co., Springfield, O.
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Indianapolis Switch & Frog Co., Springfield, O.

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Rail Joint Co., New York City.
Weir Frog Co., Cincinnati, O.

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Indianapolis Switch & Frog Co., Springfield, O.
Industrial Supply & Equipment Co., Philadelphia, Pa.
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Ties, Steel.
Universal Metallic Tie Co., Salt Lake City, Utah.

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Cooks Standard Tool Co., Kalamazoo, Mich.
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Hubbard & Co., Pittsburg, Pa.
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Chicago Bridge & Iron Works, Chicago.
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Johnson Wrecking Frog Co., Cleveland, O.

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Coe's Wrench Co., Worcester, Mass.

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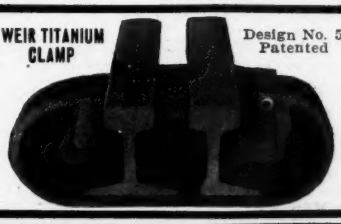

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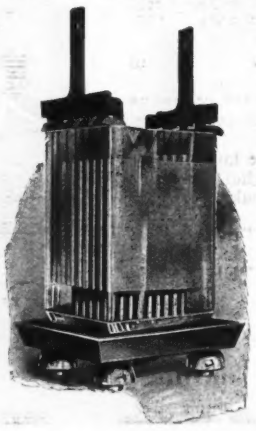

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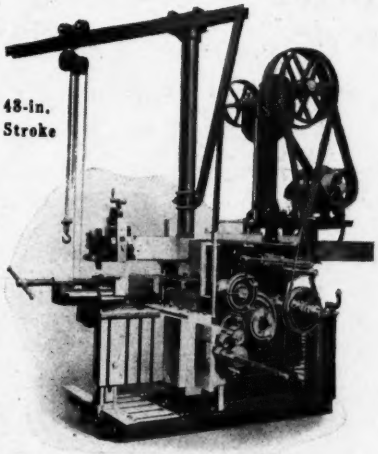
A Machine for the ENGINEERING Department



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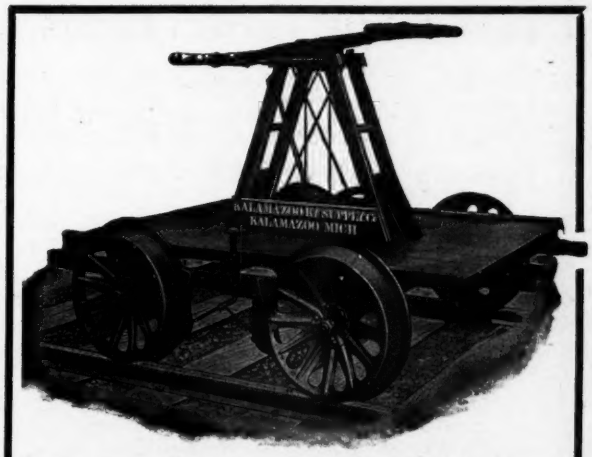

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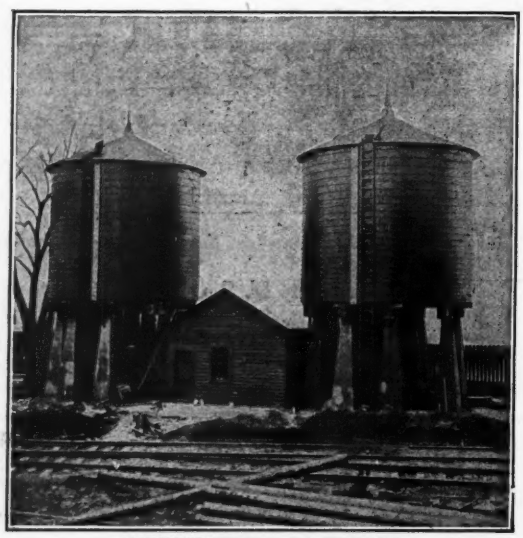

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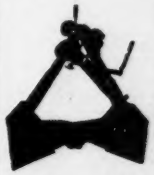

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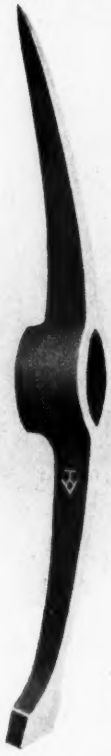

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